This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

KF
17038
NEDL TRANSFER
HN 4RL6 C

CONTRACTS and SPECIFICATIONS

PLANT - ZAPF

HARVARD ENGINEERING SCHOOL

AMERICAN SCHOOL of CORRESPONDENCE
CHICAGO ILLINOIS

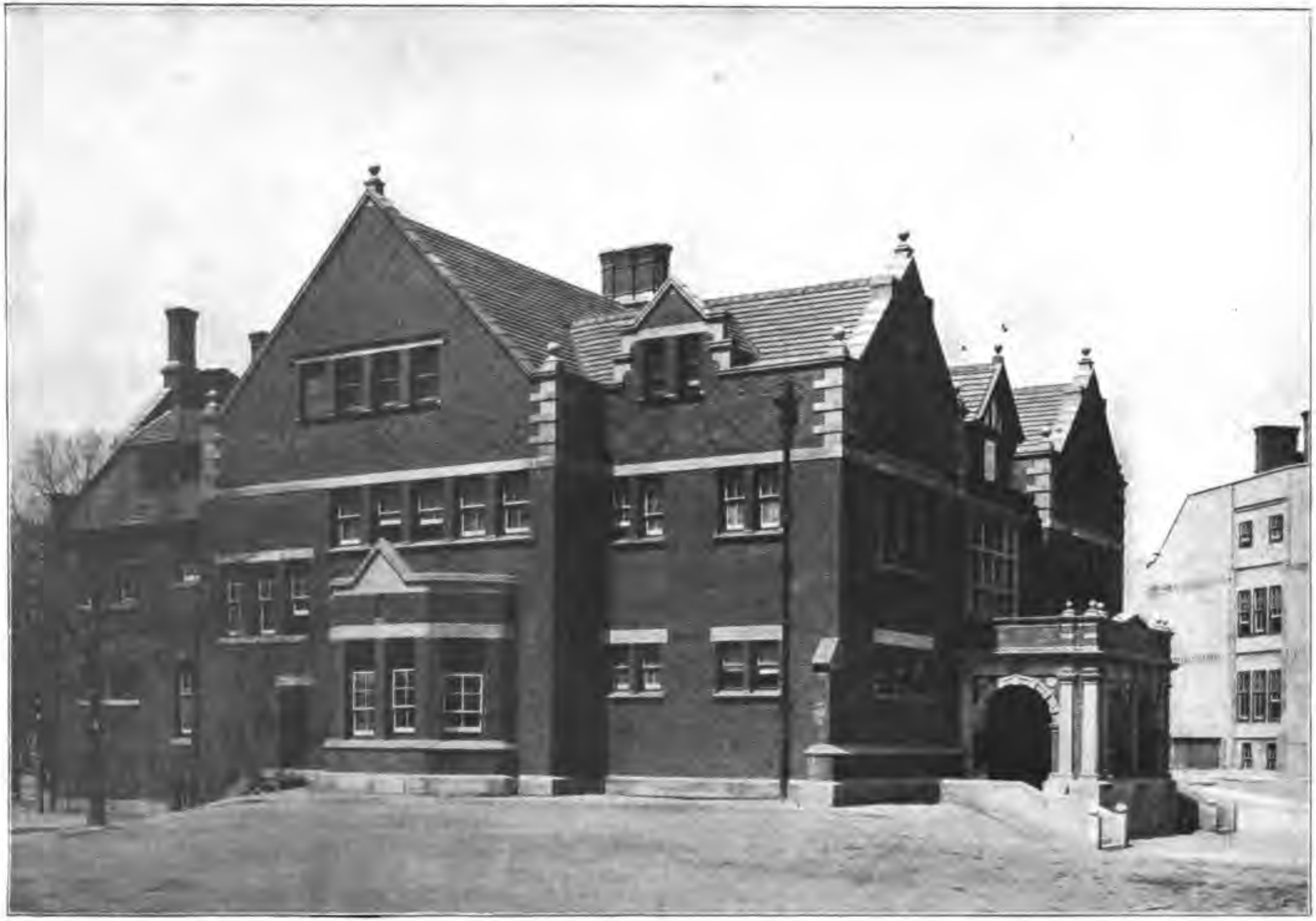
KF 17038

Harvard University

LIBRARY OF THE

DIVISION OF
ENGINEERING

~~DEPOSITED IN THE LIBRARY
OF THE
MASSACHUSETTS INSTITUTE OF
TECHNOLOGY~~



DOUBLE-COTTAGE DORMITORIES, PARENTAL SCHOOL, MAYFAIR, ILL.

W. B. Mundie, Architect, Chicago, Ill.

Built in 1904. Cost, $40,000. Walls of Paving Brick, with Bedford Stone Trimmings. Roofs of Interlocking Red Shingle Tile.

Contracts and Specifications

A Working Manual of

CORRECT FORMS COVERING THE RELATIONS OF ARCHITECT, CONTRACTOR,
AND OWNER, METHODS OF AWARDING AND EXECUTING PUBLIC
AND PRIVATE CONTRACTS, AND INSTRUCTION IN
THE ART OF SPECIFICATION WRITING

PART I

By JAMES C. PLANT
Superintendent of Computing Division, Office of Supervising Architect,
U. S. Treasury Department, Washington, D. C.

PART II

Edited by ALFRED E. ZAPF, S.B.
Secretary, American School of Correspondence,
Chicago, Ill.

ILLUSTRATED

CHICAGO
AMERICAN SCHOOL OF CORRESPONDENCE
1908

2 19

KF 1703 [illegible]

9 June 1910
HARVARD UNIVERSITY
DEPARTMENT OF ENGINEERING.

HARVARD
UNIVERSITY
LIBRARY

COPYRIGHT 1907 BY
AMERICAN SCHOOL OF CORRESPONDENCE

Entered at Stationers' Hall, London
All Rights Reserved

Foreword

IN recent years, such marvelous advances have been made in the engineering and scientific fields, and so rapid has been the evolution of mechanical and constructive processes and methods, that a distinct need has been created for a series of *practical working guides*, of convenient size and low cost, embodying the accumulated results of experience and the most approved modern practice along a great variety of lines. To fill this acknowledged need, is the special purpose of the series of handbooks to which this volume belongs.

❡ In the preparation of this series, it has been the aim of the publishers to lay special stress on the *practical* side of each subject, as distinguished from mere theoretical or academic discussion. Each volume is written by a well-known expert of acknowledged authority in his special line, and is based on a most careful study of practical needs and up-to-date methods as developed under the conditions of actual practice in the field, the shop, the mill, the power house, the drafting room, the engine room, etc.

❡ These volumes are especially adapted for purposes of self-instruction and home study. The utmost care has been used to bring the treatment of each subject within the range of the common understanding, so that the work will appeal not only to the technically trained expert, but also to the beginner and the self-taught practical man who wishes to keep abreast of modern progress. The language is simple and clear; heavy technical terms and the formulæ of the higher mathematics have been avoided, yet without sacrificing any of the requirements of practical instruction; the arrangement of matter is such as to carry the reader along by easy steps to complete mastery of each subject; frequent examples for practice are given, to enable the reader to test his knowledge and make it a permanent possession; and the illustrations are selected with the greatest care to supplement and make clear the references in the text.

¶ The method adopted in the preparation of these volumes is that which the American School of Correspondence has developed and employed so successfully for many years. It is not an experiment, but has stood the severest of all tests—that of practical use—which has demonstrated it to be the best method yet devised for the education of the busy working man.

¶ For purposes of ready reference and timely information when needed, it is believed that this series of handbooks will be found to meet every requirement.

Table of Contents

REQUIREMENTS IN MATERIAL AND WORK . . . . . Page 1

Relation of Specification to Working Drawings—Mutual Rights and Responsibilities of Owner and Contractor—Essential Qualifications and Duties of the Specification Writer—Outline of Work and Preliminary Survey of Site and Conditions—Studies in Materials—Sand—Testing Sand for Concrete—Portland Cement—Tests for Fineness, Time of Setting, Soundness, etc., of Cement—Non-Staining Cements—Lumber for Construction and Finish—Roofs—Waterproofing—Ambiguous Terms in Specifications—Bill of Quantities—Electric Wiring.

OUTLINE SPECIFICATION FOR A RESIDENCE . . . . . . Page 22

Contract and Detail Drawings—Changes—Accepted and Rejected Materials—Responsibility of Contractor—City Laws—Employer's Liability Insurance—Ladders and Scaffold—Samples—Contractor's Foreman—Drawings and Specification—The Architect—Payments—Time—The Site—Excavation—Backfilling—Sewer and Water Connections—Masonry Materials—Masonry Construction—Carpentry Materials and Construction—Hardware—Roof—Canvas—Tile—Gutters and Conductors—Plastering—Paint—Glass—Plumbing—Gas Piping—Heating—Cleaning Up.

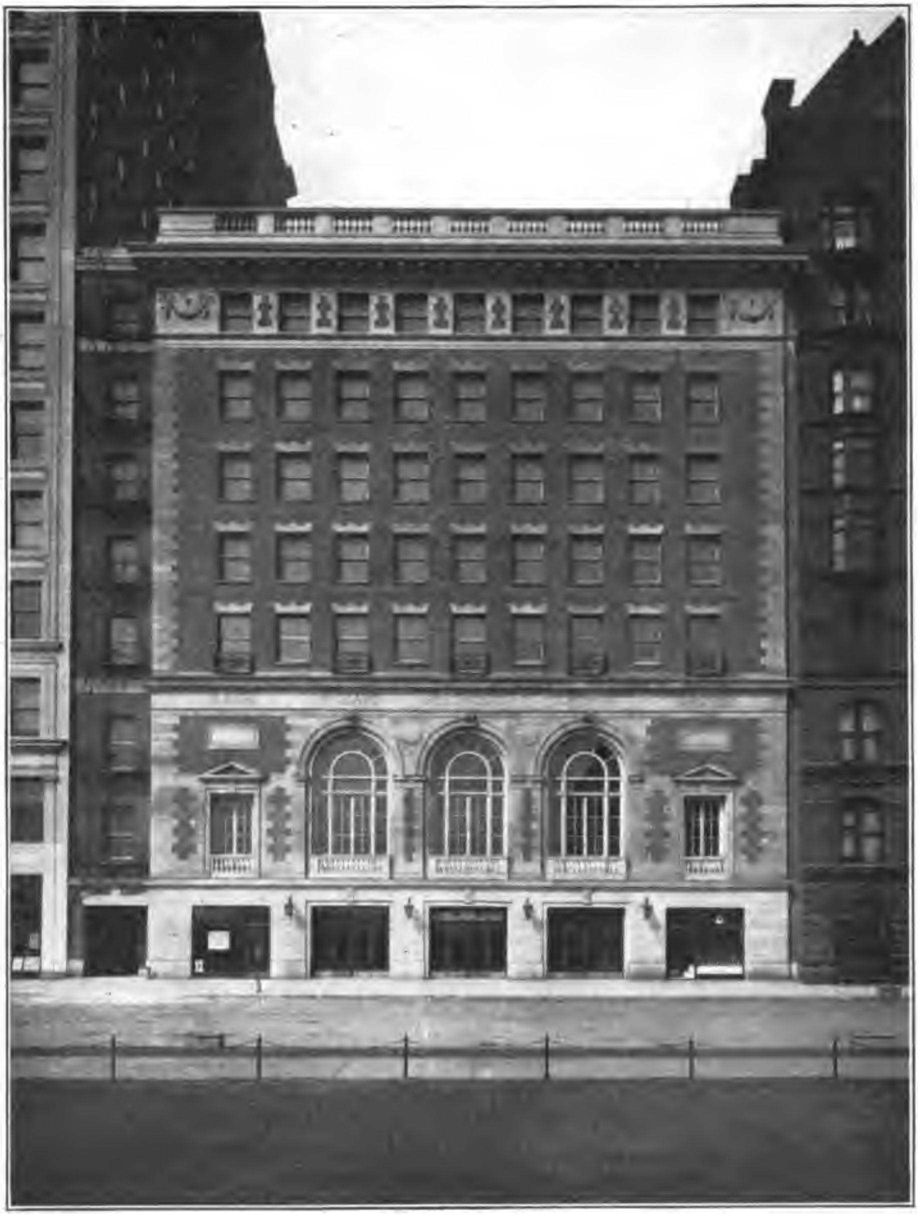
FORMAL CONTRACTS, BONDS, ETC., PRIVATE AND PUBLIC . . Page 45

Proposal Sheet—Form of Agreement between Owner and Builder—Form of Supplementary Agreement Covering Changes—Architect's Certificate to Owner—Contractor's Receipt to Owner—Owner's Receipt for Insurance Policies—Government Contracts—Volume of Public Construction Work—Character of Public Buildings—Departmental Building Conditions and "Red Tape"—Form of U. S. Government Contract—Form of Bond Required by Government.

APPLICATIONS TO VARIOUS SPECIAL PHASES . . . . . Page 67

General Scope of the Specification—The Architect's Unique Position—Methods of Payment on Contract—Specification Reminder (General Conditions; Excavation and Grading; Stonework; Brickwork; Lathing and Plastering; Metal Work; Carpentry, Framing, Exterior and Interior Finish, Hardware, Glazing; Painting; Heating; Plumbing; Gasfitting; Electric Wiring)—Typical Detailed Form of Specification.

INDEX . . . . Page 109



ORCHESTRA HALL, CHICAGO, ILL.

D. H. Burnham & Co., Architects, Chicago, Ill.

Exterior of Brick and Bedford Stone; Cornice of Terra-Cotta. Completed in September, 1905. On the Left Stands the Railway Exchange Building; on the Right, the Pullman Building.

CONTRACTS AND SPECIFICATIONS.

PART I.

In order to build intelligently and with profit, it is essential—after the scheme has been developed on the drawings—that the materials and their qualities be so selected and designated that there can be no misunderstanding relative thereto, on the part of either the Owner or the Builder, and that only such materials be required as the former is prepared to pay for.

GENERAL PROVINCE

The province of a "Specification" is to supplement the drawings, setting forth those points in the proposed work which cannot be readily expressed by diagram (and figures). It may therefore be said that its principal object is to define the general conditions under which the work is to be done, and describe the quality of the materials to be used.

Its literary side should be considered, so that it will be a continuous description of the matter, dealing fully with each subject or each part of the work in proper sequence, and, after so dealing, never reiterating the requirements either in whole or in part. Short sentences referring first to one subject and then to another of doubtful relationship, should never be allowed.

Before a specification is begun, its limits are fixed by the drawings; on them the scheme is illustrated fully, the material indicated in a general way, and all sizes shown. It is the imperative duty of the specification writer,

(1) To acquaint himself most carefully with all that is illustrated by the drawings;

(2) To determine all that is not.

Having settled in his mind this second point, he has the province and the limits of his work before him; for, as above stated, it is the province of the specification to set forth those points which cannot be explained by the drawings. A most careful study of the drawings, therefore, is necessary in order to see every point in the proposed scheme which they do *not* cover—which points must be covered in the specification.

To attempt to enforce requirements already fully shown by the drawings, by calling attention to them again in the specification, while it adds nothing in the way of obligation, has the effect of casting doubt on those requirements which are not thus doubly set forth.

A careful consideration, then, of the province of the specification will show that its functions are to define the relations between the different parties, the conditions under which the work is to be done, and the materials used in execution. These are the points which have everything to do with the cost of the work. In building, as in most other items, the form and shape have less to do with the cost than have the conditions under which the work is done and the materials required therefor.

Specifications should never impose conditions which can involve the contractor in any unnecessary trouble or expense. They should aim so to modify all conditions that there will always be a feeling on the part of the contractor that there is a co-operation with him to produce the desired result without unnecessary expense or inconvenience. The result desired should always be apparent in the wording of the specification; the means of obtaining that result should —except in rare cases—be left to the contractor, who is alone responsible for such result.

The payments on the contract, while so arranged as to protect the owner fully against over-payment, should be arranged in such a way as to require the use of a minimum amount of capital on the part of the contractor, and to render it possible for him, if his capital is limited, to discount all his bills and pay his labor promptly. This co-operation is all for the interest of the owner, as it is evident that a much larger number, and often a much better class of men, will figure on work when such a spirit prevails than when specifications seem to point to a domineering spirit.

Sometimes it is imagined, that, unless the conditions are set forth with some degree of harshness, the owner will feel that sufficient protection to his interests has not been provided, etc.; but, before the completion of the work, he will probably see in the smoothness with which the work progresses that the tact of his architect has saved him much annoyance and a considerable sum of money.

The same spirit should govern in regard to the materials required; and, whereas in the above the spirit of tact (*the business spirit*) must govern, in the matter of material on the other hand, technical knowledge may be shown. By this, it is not intended that the technical knowledge should be exercised to find out and require what under a general analysis would be called the best materials of each kind, but rather those materials which in this particular case will be sufficient at the minimum cost.

It is probable that with the beginner, as oftentimes with many others, the matter of how far the money can be made to go will be the first problem—whether, for example, for $5,000 results which ordinarily require $6,000 can be obtained. To meet this demand, it is evident that the specification writer must use his technical knowledge to determine what are the cheapest and poorest materials he can satisfactorily use to accomplish the result. The old expression, "the best is the cheapest," is often used as a cloak for ignorance of how to use anything but the most expensive.

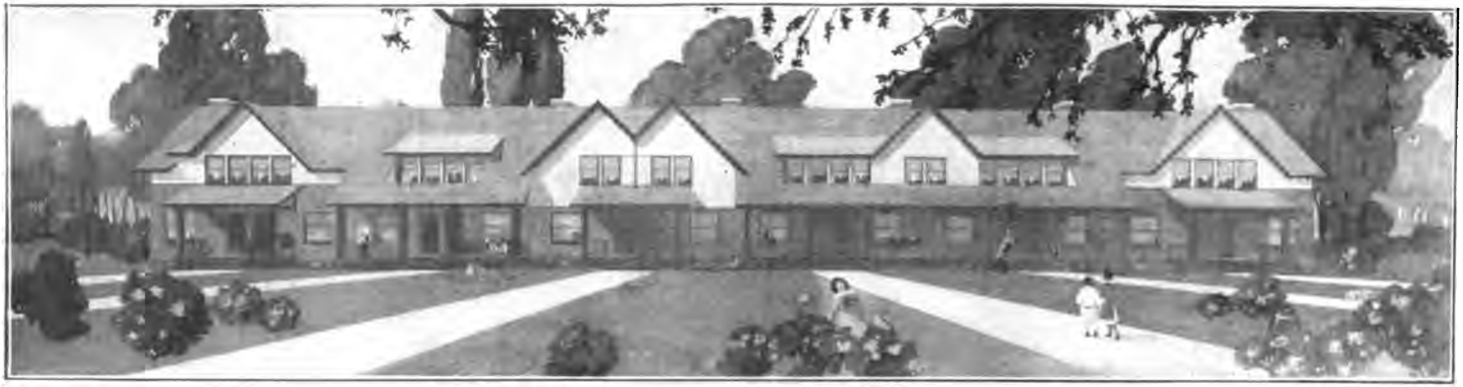
"Standard specifications," which require "standard materials," put in by "standard methods," have done their part most fully to discourage owners, contractors, and finally architects. The same judgment used in buying supplies of life that will satisfy requirements, should be used in buying building material; and success in buying depends on knowing how poor, as well as how good, to buy.

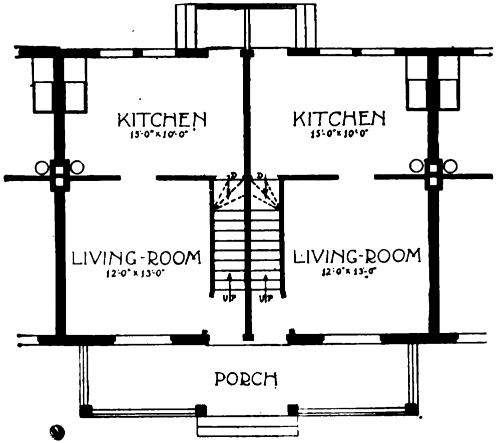
The Owner. The *owner* is the autocrat; his wishes are to govern; and, unless his interest can be thoroughly aroused, the transaction will probably end unsatisfactorily. There is no person so hard to serve as one who, while feeling it necessary to build, has no interest in the process. When done, the work will never be quite what he thought it would be, and he will never be satisfied. Therefore, if possible, his interest should be enlisted concerning as many details of materials as possible, and the reason for using one and not another. His questions will at first be trying. Possibly the first query will be, how much greater per cent will be the cost of a brick or stone-faced house over wood; and no amount of argument or explanation will convince him that no definite ratio exists. But the question can be used as an excuse to discuss the different qualities of brick or kinds of stone which he likes; and soon technical knowledge of these materials will awaken an interest and call out more rational questions. This will reveal what kind of materials are satisfactory, and an estimate quickly made will answer the question.

It is the right of the owner to understand all the differences in quality of materials, and why they are to be used. If he does not, he will probably be much annoyed by the wiseacres, who are sure to criticise everything delivered on the site, and the end is apt to be severe criticism of the architect, who "did not know enough to specify the best." It will rarely occur to the owner, that, had the best been specified, it would have carried his building well into the hands of the mortgagee. This interest, too, will lead to co-operation with the architect and the contractor, which will lead the owner to "give and take" in minor matters, to the mutual advantage of himself and the contractor. It is, further, his right to have freaks and notions; and, after a careful presentation of the case, his ideas as to materials, though they may be decidedly different from those of his architect, should be respected, and the material incorporated as dictated by him. Herein is the opportunity for the architect to use his best technical knowledge, and so meet the conditions that in spite of them the result will be satisfactory. The architect who says that he carried out the dictations of the owner and is not responsible for the result, is apt to lose a patron and possibly make an enemy.

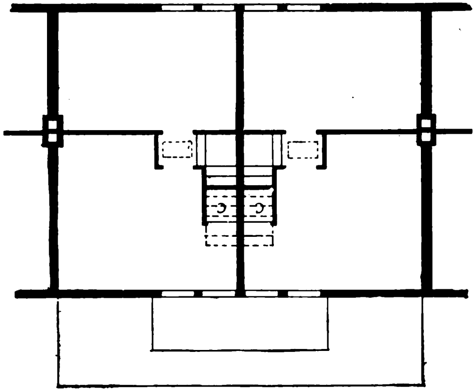
The Contractor. As a general thing, the only object the *contractor* has in mind in taking the work is the pecuniary profit to himself in the transaction. It is rarely that satisfactory results can be obtained from a man who is losing money; generally he so manages that the owner is as great a loser, and the architect is blamed for the losses of both.

While the contractor is under obligations, after taking the contract, to carry out the work "as directed," it is well to remember that his assumption of the contract was a purely voluntary act on his part, and that he was under no obligation to take it. It is his right to know, before he puts in his bid, just what he is expected to furnish and to do, and not to be left to furnish what in the judgment of some one not interested in him are materials of "best quality" or "good quality." Nothing will so much tend to draw from him the best results, as to

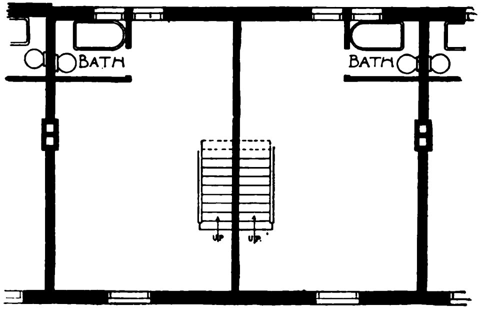




First-Story Plan.



Second-Story Plan.



Attic Plan.

BLOCK OF TWELVE WORKINGMEN'S HOUSES FOR INDIANA STEEL CO., AT GARY, IND.

Dean & Dean, Architects, Chicago, Ill.
Paving Brick Veneer and Plaster; Tile Roof.

feel the sentiment of co-operation before referred to on the part of the owner and the architect.

The Specification Writer. The central figure in this transaction is the *specification writer*. His tact must arrange the conditions under which the work is to be done; his technical knowledge must supply the data, and set forth in clear, explicit language the description of the material which the contractor is to furnish and the owner is to accept. He is to be the arbitrator when any question arises affecting the interests of both in conflicting ways; and for his comfort the arbitration must be such that both sides will see its full justice. In order that the necessity for arbitration may arise as seldom as possible, it is the more necessary that all the conditions and questions liable to cause misunderstanding be fully studied and settled in the specification. It is the duty of the superintendent to see that the contractor follows out the requirements of the specification; but it is unfortunate to have the specification so loosely written that the requirements are ambiguous or at least not explicit and the contractor is made to feel that he is distrutsed, or that he is obliged to furnish materails or labor at a loss under an arbitrary decision, which, had he been more fully informed as to the detailed requirements, he would not have done.

(Particular attention is called to the following paragraph, as the advice contained therein is of the utmost value.)

Thus, the specification writer must be a man of tact and technical knowledge. It is outside the scope of this paper to discuss the former quality except in a most general way; but it will be its object so to treat the technical side that the student can develop such lines of *thought* as will enable him, whenever questions arise, to attack them from such points as will gain for him the necessary inside information; and it is in no sense its intent to set up such matter as will serve as models and forms to be applied to miscellaneous conditions. His training as a specification writer should be such as to accustom him *to think in building material*; and when the habit is formed, the student, in passing structures completed or in course of construction from day to day, will constantly find himself reasoning as to the use of various materials. This is technical education. No school, no matter how long or how thorough its course, will cover all the points to be decided in the first modest specification. All the training any school can give is to teach a man to think out the solution of his first and each succeeding commission along sound lines. This is the character of work which rouses enthusiasm in the worker and without which the work will amount to little.

OUTLINE OF THE WORK

For illustrations in connection with the following pages, the construction of a city house is selected, on a corner lot 100 feet front on the Avenue, by 150 feet deep, on side street, a party wall on the inside line. The house is to come out to the Avenue sidewalk line, with coal vaults under sidewalk. The Avenue in front is paved, with curb and sidewalk in place. There are no improvements of this character on the side street.

A careful outline of what the specification is to treat should be made before any of the actual writing is begun; and inasmuch as the scheme has been developed on the drawings, and the only object of the specification is to supplement these, a most careful study of the drawings should be made, keeping in mind the question of conditions and materials. Notes should be taken of the different classes of subjects which will supply the headings for the specification; and very largely on the arrangement and completeness of these notes will depend the success of the specification, which should never be begun until the last note is taken and the whole arranged in proper sequence.

With the completed scheme in mind, the site is visited and studied as carefully as were the drawings. It is found that a fence is necessary to prevent careless teamsters driving over the adjoining property. The curb and sidewalk have been placed under the direction of the city authorities, and must be carefully protected. There is a large tree on the lot, which, with two in the street, must be saved. In matters of this kind it is useless to stipulate that the contractor is to be responsible for any damage to the tree, and then leave it unprotected. After some teamster has damaged it, there is nothing the contractor can do to put it back or to pay for the damage. A definite protection should be included in the contract work. There will be little use to try to preserve sod or shrubs. When the work is completed, it will usually be found that the grades are changed just enough to destroy the sod, and the shrubs had better be located elsewhere. All the room on the lot will be valuable to the contractor for working space and piling material, which point he will not fail to see in making his bid; or—to put it otherwise—if he is confined to narrow quarters and required to protect the grass and shrubs, he will add a round figure for the additional work and inconvenience.

The city authorities must be consulted relative to the amount of roadway which may be used, the guards they will require in the way of barricades, temporary sidewalks, and red lights at night.

The question of where the sewer and the water main are to be tapped must be settled; and it is usually better to have both connections made under a special contract before any work is done under the general contract, as the sewer will possibly be needed to keep storm water from the excavated space, and water will be needed at once for masonry work. If the street has been paved, it is probable that both sewer and water main have been brought to the curb.

It will be of advantage, if, at this point, the owner will have three or four small test-holes dug. Borings are of doubtful value; and often, in uncertain soil, a great additional expense is entailed after the award of the contract, on account of necessary substructure work. Often clauses are inserted in the specifications, requiring the contractor to be responsible for any bad spots found, and to do all necessary work to make them good, so that test-pits are considered unnecessary. Since, however, under such conditions, the contractor will always figure for the worst, and the owner pays for it, it is better to know just the kind of bottom you are to have for the building. In digging these pits, the knowledge of the various kinds of soils to be encountered will be of value. The specification writer can with certainty know how much good material can be used for filling and grading of the lot, and how much worthless material must be hauled away. If any sand is encountered, tests should be made to determine its value for mortar. (See later "Studies in Materials".) This knowledge will have its influence on the bidders in making up their proposals.

It is not here presumed that the case under consideration involves extensive protection of adjoining walls, or that excavation is to be carried below, or shoring done. Such cases are comparatively rare; and, as each case involves questions not of a general nature, it is outside the scope of a paper of this character to discuss this phase.

STUDIES IN MATERIALS

The primary object of this paper is instruction; and there are introduced here certain problems carried along lines which show the particular qualities of the material under consideration. Special attention is called to the fact that these problems are not introduced merely to illustrate the qualities of the particular material, but to indicate lines of *thought* to be followed in considering *every* material.

There are a great many things taken for granted in connection with building material—many old beaten paths which lead one from tradition to nowhere. The sooner the specification writer accustoms himself to testing everything he handles, the sooner he will be master of the situation. If this work is ignored, and he follows only beaten tracks—and the information of "Material Men"—he will be in hot water most of the time.

In specifying materials, one maxim should always govern: *Never specify a quality which you cannot demonstrate exists, or forbid a quality or ingredient you cannot detect.* For instance, if you are not prepared to have a chemical analysis made of the Portland cement don't say anything about sulphur or magnesia; clauses of this kind may sound well, but they may cause you trouble if later you cannot tell anything about the composition of the material. If you depend on the analyses as made by the manufacturers, you can depend on it that you will never find a cement with a harmful percentage of either.

The problems will be on the following subjects—*Sand, Cement, Lumber, Roofs.*

In addition to the work along the lines laid out, the powers of observation should be so cultivated that in the daily routine, wherever work is encountered, the eye will be ever ready to detect any phase of development in material.

SAND

Sand will be considered only in connection with cement (Portland cement). See notes under caption, "Cement." The province of sand with cement is similar to that of brick in masonry, on a small scale. The cement acts in the same capacity as the mortar surrounding the brick. If a brick could be made the size of the complete wall there would be no need for mortar, but as it cannot, mortar is required to fill thoroughly all spaces between the bricks and to adhere to each tenaciously so as to form one solid mass. If on the sides of the brick should be placed thin layers of soft clay, the bond would be broken, inasmuch as the clay would not cling tenaciously to the brick and would prevent contact with the mortar; therefore, to obtain a good brick wall, each brick must be clean and free from coating of foreign material, so that the contact with the mortar will be complete.

To return to sand—in the same way, each particle must be entirely separate from any other, and must be free from foreign coatings which would prevent its contact with the cement or would cause the particles to cling together so as to prevent the thorough coating of each particle with cement. The usual requirement for sand to be used with cement is that it shall be clean, coarse, and sharp; and that rarely should over three volumes of sand be used to one volume of cement. In our case, however, we must be more economical—we find in our pits a soft, fine sand, which, while it separates well, resembles ground clay when rubbed between the fingers. Before throwing it out as useless and paying a round price for sand hauled in, let us see what can be done with it.

Make frames of wood screwed together which will provide 32 moulds for cement bricks 2 inches long, with ⅞-inch section, by using two long strips ⅞-inch square divided by ⅞-inch divisions so as to leave 2 inches clear between each, all to be oiled. In these spaces we are to mould our small bricks for test. (See Fig. 1.) Obtain some clean, coarse, sharp sand for comparison, and also some of the fine soft sand from the site; carefully mix (dry) enough cement with sand to form four bricks of each kind, first in proportions of 3 sand to 1 cement, then of 4 sand to 1 cement, then of 5 sand to 1 cement, and lastly of 6 sand to 1 cement—eight batches in all, one-half of which will be of sand from the site, the other of imported sand. Each batch should be mixed with greatest thoroughness in order that every side of every particle of sand shall

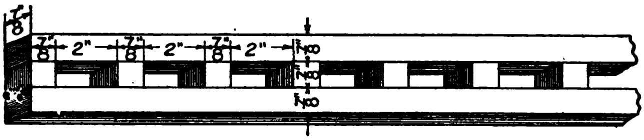


Fig. 1. Frame for Moulding Cement Test Bricks.

become coated; then add just enough water to thoroughly dampen, and crowd the mixtures into the moulds (which should be laid on a smooth plank, for bottom), compressing each as much as possible. If water appears on top, it will indicate that too much has been used in mixing. Then there will be four bricks of each batch. Place on each an identifying mark—

No. 1	3–1	Standard	sand		No. 5	3–1	Common	sand
" 2	4–1	"	"		" 6	4–1	"	"
" 3	5–1	"	"		" 7	5–1	"	"
" 4	6–1	"	"		" 8	6–1	"	"

Cover with a damp cloth to prevent evaporation; and after one day, draw out the screws holding the forms, and put the bricks for two weeks in a damp place, covered with a wet cloth or in water. Obtain two good, smooth planks about 3 feet long by 1 foot wide; go to a neighboring foundry, and obtain permission to use their scales and a few hundred pounds of pig iron; lay down one plank on a perfectly level bed, and place the number 8 brick on their sides. (See Fig. 2.)

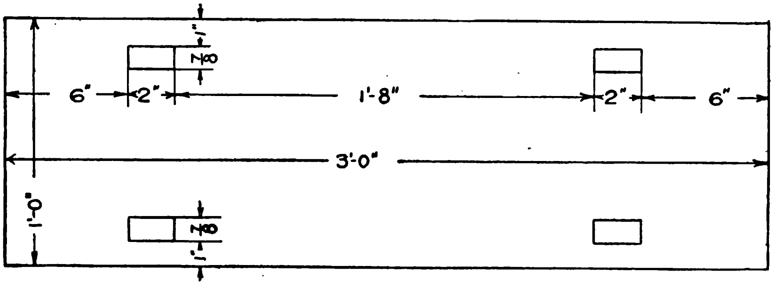


Fig. 2. Method of Testing Cement Bricks for Crushing Strength.

In order to get an even bearing it is well to place below and over the cement bricks one layer of soft building paper; above place the second plank with great care, seeing that it has a firm, even bearing at each of the four bricks. Carefully lay pig iron above, beginning at the middle, and fill each way, never loading one end before or with a much heavier load than the other. Carefully watch the bricks; note when they crack; and when they crumble, weigh the pig iron and note the results.

As above, test each of the remaining seven sets of bricks.

It is safe for ordinary dwellings to select the cheapest materials and mixture which will carry under such conditions 500 pounds of iron.

For example, it is supposed that No. 3 sample, made up of 5 parts coarse sand to 1 part cement, carries the same load as No. 6 (4 parts sand from the site to 1 part cement). If it costs $1.50 for one cubic yard of coarse sand, and 50 cents a yard to haul the sand away from the excavation, the coarse sand costs us for use $2.00 a cubic yard, or 7.4 cents a cubic foot. With cement at $2.00 a barrel, we have:

Cost of 5 cubic feet of sand	37 cts.
Cost of 1 cubic foot of cement	67 cts.
Cost of 5* cubic feet of mortar	$1.04
or	20 $\frac{4}{5}$ cts. a cubic foot.

Using sand from the site in mixture No. 6 (4 sand to 1 cement), we have the cost per cubic foot as follows:

Cost of 4 cubic feet of sand	Nothing
Cost of 1 cubic foot of cement	67 cts.
Cost of 4 cubic feet of mortar	$0.67
or	16 $\frac{3}{4}$ cts. a cubic foot.

It will thus be seen that it is cheaper to use the 4 to 1 mixture and the poorer sand from the site, than to haul it away, bring in other sand, and use less cement. If, on the other hand, it is found that it will require No. 5 to equal No. 3, it will be cheaper to haul away the excavated sand and haul in good sand.

Before breaking the bricks, they should be very carefully examined as to texture and firmness. Scratching with the finger-nail will show the general quality to the student after a short experience, so that experiment with weights is unnecessary after the student has become familiar with the appearance of good mortar.

After the bricks are broken, examine the fractures, and observe with a glass how well the spaces between the particles of sand are filled. Generally the results will be about in this order:

No. 1 will show much greater strength than the corresponding No. 5. No. 2 and No. 6 will show less difference. Possibly No. 3 will break under less weight than No. 7; while No. 4 will go to pieces much before No. 8. The reason for this is readily detected under a glass. The imported coarse sand requires much more cement to fill the spaces. In No. 1 they are all filled; while in No. 4 there are large voids, which do not occur to such an extent in Nos. 7 and 8; the sand being finer allows smaller voids. *Observe* that the increase in the number of voids or small holes in the mass weakens the mixture.

---

*NOTE.—When sand and cement are mixed in proper proportions, the bulk of the mixture is not greater than the bulk of the sand, as the cement only fills the voids or spaces between the particles of sand, just as there can be poured into a full measure of shot 20 per cent of water without overflowing the measure.

Now try one other experiment. Get two forms from which 4-inch cubes can be made; make a mixture of possibly 4 fine sand to 1 cement; mix one with a large amount of water, as is usually seen in ordinary work; and from this form a 4-inch cube. Mix for the other cube the same proportion, but with just enough water to change throughout the color of the mass. Crowd the mixtures into the form, both cubes to be compressed as much as possible; set the cubes aside, covered with a wet cloth for a week; then split with a cold chisel, and observe. The interior make-up of that mixed with a larger amount of water, is full of voids; that mixed with little water is compact.

The question of sand is treated, as later the question of roofs will be, in a great deal of home-made detail, not only to get at the question of sand and roofs, but to illustrate how, with materials that are always at hand, results of great practical value may be obtained.

CEMENT

There is probably no other building material on which so much has been written within the last ten years; and there will be no attempt here to discuss the question except from an extremely practical standpoint. All things considered, Portland cement at $2.00 a barrel net is the most economical material to be used in general masonry. Lime is much cheaper, but of very doubtful value as generally used. The English, Scotch, and French use lime with great success; but it is always slaked in pits for at least three months prior to use, and is treated and worked so as to make it valuable for mortar, while in this country it is used after such crude treatment that it cannot be considered a material suitable for good work. Therefore lime in any form will not be further considered for masonry work.

There are now three classes of Portland cement on sale in this country. By far the largest class is that ground from an artificial clinker. Second are what is known as "slag" cements, ground largely from furnace slag. While in many of the second class the sulphur has been so far extracted as to make them identical in chemical analysis with those of the first class, and of great value in general masonry, it is wiser to avoid their use where surfaces are exposed to wear, as in sidewalks, steps, etc. Unless the work is of minor importance they should not be used unless such chemical test (independent of tests made by the manufacturers) can be obtained as will show that the sulphur therein is below 2 per cent.

The third class is one imported from Belgium under various brands carrying English names, such as "Eagle," "Star," etc., the packages, however, showing the place of manufacture. These cements are generally coarse and of low grade—possibly the factory's second grade, on which the manufacturer does not care to put his regular brand.

English cement is practically out of the market.

A few brands of German remain, like the "Dykerhoff," which commands a high price and for which there is a limited demand from users who believe there are no other brands from which quite as good results can be obtained. For our purposes, however, the second and third classes need not be considered; the range in No. 1 is wide, and little if anything is gained in price in using Nos. 2 and 3.

On important work, tests should be made to determine the fineness of grinding, specific gravity, time of initial and final set, soundness, the proportion of silica to lime, and the amount of sulphur and magnesia. Tests are also made of tensile strength; but as this is a quality never required of cement, and this test only indirectly bears on other necessary qualities; and as the presence of matter which is apt to cause final disintegration, tends often—in the early stages of use—to increase the tensile strength, such tests should be in no way relied on.

In this paper, only three tests which it is possible for the student to make with appliances easily obtained, will be considered.

Fineness. What is known as a 100-mesh sieve—that is, a sieve with 100 spaces to an inch—should be obtained. Any first-class hardware store can furnish the wire either from stock or on order and a home-made sieve can be constructed. A small quantity of cement should be weighed and most carefully sifted; 90 per cent of the material should pass through the sieve. By referring to statements relative to cement, under "Sand," the student will understand that extreme fineness is required in order that the cement may fit in and completely fill any voids which may exist between the particles of sand.

Initial Set. The time for the initial set is determined approximately as follows:

Mix a small amount of neat cement (that is, clear cement without sand) with water, to the consistency of stiff mortar; and observe the time it takes to set hard enough to prevent an indentation being made by a wire about 6 inches long and of $\frac{1}{12}$-inch diameter loaded with a ¼-pound ball on top, when set thereon. Such time should not be less than 30 minutes.

It is unwise to use cement which sets at once or in such short time that it is inconvenient to place it before such set occurs. Cement fresh from the works often takes its first set quickly; but after it has attained an age of two or three months before being used, is all right. Therefore, never specify "fresh cement," as none should be used within three months from the date of its manufacture.

Note. It may be noted that the setting quality of cement consists in the *permanent* union of water with the cement. The setting of cement mortar is often referred to as the "drying out;" as a matter of fact, the water necessary for mixing the mortar never leaves it unless driven off by extreme heat. Take a tin can with tight cover; weigh out five pounds of dry cement; mix with it enough water to wet it; pack it in the can and thoroughly compress it. If water rises to the top—indicating that too much has been added—pour it off; put on the cover tight, weigh the whole, to determine the amount of water added; and set away for two weeks. Then open, and set in a warm, dry place for a few days so that it may be thoroughly dry, and weigh. It will be found that the weight is that of the original cement plus the water added, which still remains in the mass. Subject this to extreme heat, when it will be found that the water is thrown off, the cement is fine again, and its weight corresponds with that originally used.

Soundness. This is one of the most important of physical tests, for it indicates whether there probably exist elements which will eventually disintegrate the mass. The action of pats should be carefully observed; and if warping, cracking, or blotches appear, the material should not be used. Form on small pieces of clean glass four pats of cement mixed with only so much water as will turn the color of the cement. The pats are to be about ½-inch thick in the center, and 3 inches in diameter, tapering to the edge, which will be as thin as possible. After a day under a damp cloth, put two of the pats in water for a week, and leave two in air, and examine for symptoms referred to above.

Should it be possible to test the material chemically, the following points should be observed:

The lime should be slightly over 3 times the silica. Thus, if there is 20 per cent silica, the lime should run from 60 to 62 per cent; this is a good balance. The silica should not fall below 19 per cent, nor rise above 22 per cent, which is about the range of good cements on the market.

More than 2 per cent of sulphur should never be allowed. The reason for this is that the "setting" of cement is a process in which the various materials combined unite chemically to form one solid mass. Sulphur in its various forms is an ingredient which does not work in harmony with the other materials; and while it does not at once prevent the satisfactory combination and setting of the other materials, yet, under conditions that are very likely to prevail, it sets up a chemical action tending to disintegrate the mass in time.

Magnesia can generally be considered an ingredient which has no value either as sand or cement, being what is known as "inert" material. While 4 per cent may not injure masonry, wearing surfaces should not have over 3 per cent.

The manufacturers of Portland cement have tried to eliminate both of these ingredients—but so far without success—at a cost which would make it possible to sell the cement at a profit.

The specific gravity should not fall below 3.10, as a low specific gravity indicates poor burning of the clinker. These later tests, however, are delicate laboratory operations, and only experienced chemists are capable of getting satisfactory results.

Non-staining Cements. There is a very general prejudice against the use of the ordinary Portland cement for setting limestone, sandstone, and marble, the theory being that the moisture from the mixture, in getting away, travels through the stone, carrying with it certain staining matter, which is either deposited on the surface or unites chemically with ingredients in the air to stain the face. Thus there have come to be used certain materials of much less structural value than the Portland cement. These are called *non-staining* cements, and are sold at a high price. There are also on the market many materials intended to be put on the back of stone, which the manufacturers claim will prevent the passage of moisture and staining matter. While it can easily be demonstrated that water containing cement running over the face of soft stones does leave distinct traces, it is a different thing to show that such stone or marble can be stained by materials in the joints or on the back. It is well, before any amount of money is spent, to experiment in producing the stain on the stone used with the ordinary cement.

A small box can be filled with soft mortar, and a piece of stone or marble laid therein so that the top surface is ⅛ inch above the mortar. Then, by tacking a piece of waterproof paper to the box sides, and cutting a hole somewhat smaller than the upper face of the stone or marble sample used, and by weights bringing the inner edge of the paper to the stone so that practically no moisture can pass except through the sample and off from the exposed surface, the results of the so-called staining qualities of ordinary cement can be observed.

LUMBER FOR CONSTRUCTION AND FINISH

Local conditions affect lumber very much. While the great lumber interests formulate and publish schedules of grades, the user cannot, from their designations and descriptions of grades alone, make an economical selection. The designations "first" or "best quality," "without imperfections," etc., inserted in specifications to describe the quality desired, tend to get all concerned into trouble on account of the various meanings put on these terms.

Some markets are well supplied with good spruce framing lumber, while an adjoining section will have no spruce, but good, rough pine or hemlock. The same differences will be found relative to finishing lumber. The student should visit each lumber yard; look over the stocks; find the materials in that market, how they are graded, so that he can in specifications state just what imperfections can be allowed in framing timber, boards, or finishing lumber, always bearing in mind that there is no material in existence which is free from imperfections. By observing the imperfections and stating clearly what will be allowed and what will not, he can avoid very many unpleasant misunderstandings, with the owner especially, and also with the builder.

Lumber which has the largest number of good qualities is the most expensive; therefore, for each portion of the work, material should be required having only the particular qualities required for the station.

Since, in the case of lumber, the questions of grade, quality, etc., can be determined by observation rather than by such experiments as are indicated for cement or sand, these matters will not be further treated here; but in the following specifications, there will be illustrated what consideration should be given generally to lumber grades, quality, and finishes.

ROOFS

In the previous examples or problems, attention has been given to putting the student in line of *thinking in materials.* Under this heading, consideration will be given to the combination of materials in a roof covering, partly because a good roof is one of the prime necessities of a successful structure, and also because, in a brief study of one type of roof of which a model can easily be constructed, the elements of how to *think in construction* within the province of the specification can be clearly illustrated. The particular covering considered is canvas. Undoubtedly each student is familiar with the use of canvas, as a deck covering for steamships, sailing vessels, etc., down to the small duck-boat completely constructed of canvas; but it is possible that few have ever considered the various steps necessary to make it available for water and wear-resisting uses.

Canvas is a material which, in its natural condition, is far from waterproof, and is one of the materials most easily and quickly destroyed by mildew. Its one original desirable quality is its extreme strength and toughness. Therefore there must be incorporated with this tough material, the properties of resisting the passage of water and the ravages of decay. Take a good sample of 10-oz. duck; put it on a board, and strike a dozen times in one place; take up, rub in the hands, and observe how little damage has been done to the texture.

Build up of $\frac{7}{8}$-inch matched flooring dressed on the upper side, a board about 3 feet square, putting 2 by 4-inch cleats on the under side. These cleats represent the rafters, the $\frac{7}{8}$-inch stuff the roof boards. Obtain from different stores samples of 10-oz. duck, and mark each for identification, making a schedule in which the price of each is noted. Cut all samples to exactly the same size; and, after drying thoroughly to drive off all moisture, get them weighed by a druggist on very accurate scales, and on the schedule note the weight of each piece. Soak and wash each thoroughly, rubbing so as to remove all size or filling *soluble in water*. After thoroughly drying, have each carefully weighed again, and note the weights on the schedule. From this schedule can easily be determined, which is the best for the money. It may be found, for example, after soaking out all soluble matter, that the material which costs 18 cents a yard is considerably cheaper than that costing 17 cents.

A choice having been made, buy a yard; and, when thoroughly dry, secure it with ordinary tacks about $\frac{5}{8}$-inch long, spaced one inch apart, to the boards prepared, stretching it as much as possible so that it will be tight and flat. Wet it thoroughly and *observe* that wetting has a tendency to shrink it; but, as it cannot shrink on account of being securely nailed to the board, each thread is drawn very tight and made smaller. By examining closely, it will be seen that the spaces between the threads are increased and that water will run through as through a sieve. When in this condition, put on a good coat of white lead and oil paint (this is about the only material which should be painted wet), and *observe* that a large amount of paint is taken up; in fact, through the openings between the threads, the paint goes, reaching and covering the underside of the cotton. The water will not unite with the paint, and passes off before the paint dries, allowing the threads to swell into the soft paint, so that when the paint is dry the fabric is practically embedded in paint, with less on the upper surface than anywhere else. Two more coats on top furnish the necessary protection. This treatment protects the canvas from mildew and makes it waterproof; the original fabric furnishes the strength.

After the paint is dry, subject the sample to the harshest of treatment. Grind with the heel, drop bricks, etc., to see just how much it will resist; if not successful in making a hole, use a hatchet, patch the hole so made by tacking over it a piece of duck of sufficient size to cover it; and wet it, paint it, etc., as before. When dry, place the boards level, nail down 1-inch strips around the edge, laid in white lead, and cover with one inch of water. Let this stand for forty-eight hours. Now cut up the duck, and see if any leaks exist; if so, carefully examine the covering to determine exactly the cause. Next, roll the duck loosely, and put away for two weeks in a dark, damp place, and then examine for mildew.

It is not the intention of the above problem merely to explain how a canvas roof is made, but to set the student to thinking about roofs. A shingle roof, or a tar-and-gravel roof, or a slate roof, differs from the above only in the manner in which it accomplishes the same ends; and all other styles should be observed and studied along similar lines, so that the proper material will be used in each of the different varieties of buildings.

USE OF WORDS AND GENERAL REQUIREMENTS

It should be the object of every specification writer to have the words as exact in the expression of requirements relative to materials as are the drawings in showing their forms; and no more words should be used than are absolutely necessary to indicate the full meaning. Frequently, after completing the specification, it is gone over to make additions. It is far better to go over it to see how much can be cut out —which operation will often astonish the writer by showing how many useless words and duplicate requirements have been inserted in the original.

Generally speaking, adjectives and adverbs and all general description should be dispensed with. A requirement that work shall be finished "in the best manner" means very little. A reasonable interpretation of "best" work for a house costing $1,500.00, would be entirely unsuitable for a house costing $15,000.00; and as all through the scale the meaning varies, it will be evident that the contractor influenced by his intent to make a profit, and the owner influenced by his desire to get his money's worth, will have very widely separated views relative to what the "best" is; and the architect is apt to get the ill-will of both in attempting to decide the question.

The fact is that the term "best" is open to a great variety of interpretations. If an oak moulded panel is to be finished in the "best" manner, we think of it as constructed with perfect symmetry of outline, thoroughly smoothed, with all machine marks removed, and filled so as to change the texture of the surface, coated and polished with four or five coats of varnish. If, on the other hand, a carved panel is described as finished in the best manner, we conceive something quite the reverse. Although it is of oak and intended for the same room, it must lack the machine symmetry, and must have a freedom in the carving in which each member shows independence of form; the tool marks should remain; and under no circumstances should the work be smoothed off with sandpaper or have a rubbed finish. These differences of meaning in the same word or term are not understood generally; and the workmen, contractors, and owners get hopelessly at odds.

In mentioning materials, they should be treated in classes, with no attempt to designate where each should be used (this designation is the province of the drawings). If an attempt is made to designate where materials are to go, and for any reason every single point is not covered in making such designations in the specifications, such omission is taken as an excuse by the contractor for an extra.

It is sometimes held that the specification should be considered as a sort of index of all the labor and materials required in the structure, and that any items not mentioned in this index cannot be required. This feature, however, is the province of the "Bill of Quantities," which in this country is always prepared by the contractor for his own use, and not by the architect. The contractor makes up the bill of quantities from the drawings and specifications which latter, together show the shape, size, and quality, but which should never attempt to state the quantity in detail.

There are certain items that cannot be shown on the drawings or required by the specification, which must be covered in a general way—such as nails and screws; but when something more than the ordinary practice is needed, this should be mentioned. Thus, floor lining should be secured by 10d nails not over 3 inches apart over each joist. Matched sheathing should have two 8d nails to each board, over each stud. Window stops should be secured by round-headed blued screws set not over 10 inches apart. While for such items as the finished floor, casings, etc., there is no necessity for specifying the number or size of nails, it should be stated that they are to be so placed that the heads will be invisible in natural finished work, and puttied in painted work.

However many general clauses may be inserted requiring contractors to do and provide work and materials necessary for unforeseen exigencies; it may be stated as a general and almost universal rule, that, when the work and materials are not clearly set forth, the owner has to pay the bill.

Where work is to be divided so that a contract is let for the masonry, carpentry, plumbing, and heating to separate contractors, the lines in which they are to co-operate must be most clearly drawn, and the special provinces of each defined.

If contract is to be awarded to one person who is to furnish the structure complete, then the matter of what work is to be done by this or that sub-contractor should be omitted entirely. The general contractor must be held responsible for results, and there should be no dictation as to which of his sub-contractors should do certain parts; nor is it the business of the architect or the owner to dictate how the different sub-contractors shall co-operate. If results are unsatisfactory from any reason, the contractor will always urge the plausible excuse that his affairs in the management of the work were so interfered with that he was unable to do the work as he wished or agreed.

ELECTRIC WIRING

The item of Electric Wiring, while entirely within the province of the architect to lay out, is of such a mechanical nature that it is rarely advisable to include it in the general specification. Few general rules outside of a set adopted by the National Board of Fire Underwriters—called the "National Electric Code"—can be formulated.

The arrangement, location, and sizes of wires are problems of delicate adjustment in order to obviate danger from fire, to prevent loss of power, and to obtain a perfectly satisfactory service at all points under the maximum load, and yet keep the amount of material down so as not to involve unnecessary expense.

Expensive instruments are necessary for the testing of the system when complete, and a considerable experience is needed even for stating in a specification what tests are to be applied in each specific case. Therefore it is not deemed best to discuss the matter further here, except to state that, for work such as that under consideration, the services of an engineer in the employ of the Electric Light Company which is to furnish the energy can generally be obtained to lay out the system and test the completed work.

In studying the **following outline specification,** it is suggested that many trade papers and the general magazines advertise appliances used in building; and a postal-card request to the advertisers will bring very useful information about the product advertised. In these lines, are cement, concrete work, stone, brick, paints, varnishes, plastering material, plumbing goods, and heating goods.

Catalogues of the two last are particularly to be obtained. If the influence of any such literature is such that the student finds himself impressed with the fact that the material or system under consideration is the best of anything in that line, then special attention should be given to the literature of other materials or systems which are used for the same purpose, until he finds some which he is satisfied are equal to it in every particular. The man who has only one material he can use, or one way of accomplishing a certain object, is sure to be either deficient in information or unduly influenced, for there is no one material, or one way of doing anything, that is "best" in all respects.

The student should also have a copy of some of the many handbooks of general information relative to materials. Of these, probably "Trautwine" will be found the most useful; for, while it is not so popular as some, it is a high authority, and in it will be found notes on every variety of material and construction.

SPECIFICATIONS[*]

FOR A RESIDENCE BUILDING TO BE ERECTED FOR

JOHN DOE

AT THE CORNER OF A AVENUE AND B STREET, CHICAGO, ILLINOIS

Richard Roe, Architect

GENERAL CONDITIONS

√ **Contract Drawings.** The drawings which will with this specification form the basis of an agreement for the erection and completion of a residence for John Doe, to be erected at the corner of A Avenue and B Street, are numbered 1, 2, 3, 4, 5, 6, 7, to a scale of ¼ inch to the foot; and details, 20, 21, 22, 23, to a scale of 1½ inches; and all materials and work necessary to complete the structure indicated, are to be furnished and done by the Contractor.

---

[*] NOTE.—These "Specifications" cover the following pages of text up to and including page 44.

Detail Drawings. Full-sized details and models will be furnished as the work progresses, and no work requiring them is to be done before their delivery. In their preparation, minor modifications will be made which do not materially affect the cost of execution; and they will be delivered to the Contractor within the following periods after the award of the contract: those which affect the construction of exterior walls, cornice, roof, or internal framing, six weeks; those for interior finish, four months; those for carving on material in place, six months.

Changes. No alterations shall be made involving change in cost, unless ordered by the Architect in writing, setting forth fully the nature and extent of the change, the terms and conditions under which it is to be made, to which the assent of both Owner and Contractor is to be attached.

The Architect will, during the progress of the work, give oral directions relative thereto; but such directions will never be considered as authorizing changes.

Accepted and Rejected Materials. The decision of the Architect will be final relative to the work or materials furnished, and that rejected is to be removed promptly from the site. It will be understood, however, that every item furnished in place in the building which is covered by a payment, is considered as accepted, and will not be later rejected unless defects develop which were not visible prior to the payment; and when, for such cause, material is rejected, the entire expense incident to replacing the material is to be borne by the Contractor.

Responsibility of Contractor. The Contractor is to be entirely responsible for producing the finished work in place; and in carrying it out, he is to furnish all tools and temporary appliances to accomplish the contract requirements, and also heat, so that after the first plaster coat is begun no part of the building shall be allowed to have a temperature lower than 40° F. If plastering is done in hot, dry weather, he is to protect the building with such temporary closures as will prevent injury from too rapid evaporation. He is to be responsible for the protection, not only of all material delivered on the site, but also of all materials in place, until the final acceptance of the building as evidenced by the final payment on the contract and the delivery of the structure to the Owner. As this responsibility extends to loss by fire, he is to keep the building fully insured in Stock Insurance Companies, the loss, if any, payable to the owner as his interest may appear; and the total amount of such insurance shall never be less than a sum 20 per cent higher than the total amount of the payments made; and prior to each payment, the Contractor shall deliver to the Owner such policies. The Contractor shall, if required by the Owner four days prior to the time any payment is due, produce evidence satisfactory to the Owner that such settlements have been made as will clear the premises from the liability of liens on account of either labor or materials furnished; and in case the Contractor fails to produce such evidence, the Owner is not under any obligations to make the payment until his demand is complied with. If the demand is not made by the Owner four days prior to the day any payment is due, the Contractor will not be obliged to furnish evidence for the payment then coming due; but the right to demand the evidence before any subsequent payment is made will continue to exist, so that the Owner may demand such evidence prior to any future payment.

City Laws. The Contractor, without the intervention of either Owner or Architect, is to comply with all City Ordinances for the regulation of building on private property and the temporary use of highways beyond the building lines.

Employer's Liability Insurance. Should any person either employed by him or not, or any property, be injured in any of the operations in connection with the building or through his carelessness or that of any of his employees, he is to be responsible therefor; and therefore he is to carry at all times Employers' Liability Insurance which will cover up to $5,000.00 the damage to any one person, either of the public or of those in his employ.

Ladders and Scaffold. The Contractor is to maintain at all times such ladders and scaffolding as will afford the Owner or Architect access to all portions of the work.

Samples. As soon as possible after the award of the contract the Contractor is to deliver on the site samples of all materials required in connection therewith. Such samples are to indicate the range he proposes to use, by one of the poorest quality and one of the best in each class, with the understanding that the material furnished is to run between the two so that the average of the material furnished will be practically the average between the two samples.

The Architect will pass on these samples; and after acceptance by him, they will be kept for guidance in passing on the material when delivered. If any of the samples, in the opinion of the Architect, are not in accord with the contract requirements, he will reject such in writing, setting forth fully his reasons, and the Contractor is to furnish additional samples in lieu of those rejected, until materials suitable in the judgment of the Architect are submitted. In executing the work, the poorer materials are to be placed in the minor portions of the work as selected by the Architect.

Contractor's Foreman. The Contractor is to have a representative fully empowered to act in all cases for him on the site whenever any work is in progress or material being delivered; and neither the Owner nor the Architect will give to anyone, except such representative, any directions or instructions. Should such representative not give proper attention to such directions or instructions, such neglect will be sufficient cause for refusal on the part of the Owner to make further payments until the settlement of the questions involved.

The protection by the Contractor, of trees, sidewalk, curb, adjoining property, etc., as required hereinafter, will not relieve the Contractor from responsibility for any injury which may occur to such protected items on account of the building operations.

The Drawings. It is the intention that the general scheme for the work shall be illustrated by the drawings, on which all dimensions and sizes are given. When features or details are evidently of a similar nature to those already shown, they will not be carried out in detail; but in all such cases the Contractor will complete the work in accordance with the evident intent of the drawings.

The materials are in general designated; and when the drawings are competent to show fully what is required, it will not be within the province of the specification, or details to be prepared later, to make further reference thereto.

The Specification. It is the intention that this specification shall cover those material points only which the drawings are not competent to cover; and the fact that certain items are indicated on the drawings, and not mentioned herein, will not relieve the Contractor from furnishing them. It is the intention that the drawings and this specification shall so co-operate that all matters in connection with the proposed structure necessary for making accurate estimates for the completion of the building, shall be fully set forth. There are, however, certain operations and materials evidently necessary for the construction; and unless these are of unusual nature, no mention thereof will be made; but such fact will not relieve the Contractor from his obligation to provide for all such items.

The Architect. The Architect is the technical adviser for the Owner, and will have the general direction and oversight of the building operations, with the right conceded by both Owner and Contractor to accept or reject finally materials or workmanship, to decide the amount due at each payment period, and to determine when the Contractor has complied with the conditions of his agreement.

He is not to be responsible for such items as whether or not liability for liens exists, or for such other matters of business detail as do not require the technical training for architectural practice.

As the Architect must depend on the clear requirements of the drawings and specifications for his authority in exercising his duties, it is desirable that all questions which may arise be fully settled therein, so far as practicable, before the submission of bids. Therefore all parties who propose to submit bids should, in writing, call attention to any points which in their judgment are not fully explained by the drawings and specifications, at least six days before that set for receipt of proposals; and such questions, with the replies thereto, will be forwarded to each prospective bidder; and the failure of any bidder to ask for such supplementary information will be construed, after the award of the contract, as barring him from demurring from any ruling which in the opinion of the Architect is justified by the contract requirements. In any questions of a technical character which may arise between the Owner and Contractor, the Owner will be governed by the decision of the Architect.

Payments. Before beginning the work, the Contractor, if he so desires, can prepare for the Architect a statement showing the order in which he will proceed with the construction of the building; and a schedule of the quantities of all items entering into the work, with the value of each in place—the total of such values to be the contract price. If, in the judgment of the Architect, this schedule is perfectly fair, it will be adopted as a basis of the monthly estimate of the value of the work satisfactorily in place; and on the ~~3rd~~ ~~day~~ of each month, the Owner will pay on the contract price 90 per cent of the value of the materials satisfactorily in place on the 1st, as determined by the schedule; but in these estimates, no account will, under any circumstances, be taken of the value of materials not finally incorporated in the building.

If, however, the Contractor does not elect to prepare such a schedule, or prepares a schedule evidently not fair to the Owner, then the Owner will pay to the Contractor on the 3rd of each month 90 per cent of the value of the materials satisfactorily in place, as determined by the Architect's estimate; and in determining the value, the Architect is to be governed by the total contract price, so that at all times there will be reserved by the Owner sufficient funds to complete the building, in case of default on the part of the Contractor, at usual market rates, and in addition 10 per cent.

Time. The time limit for the completion of the work will be ~~nine~~ months from the date of award of contract; and it will be a condition of the contract, that there will be deducted from the final payment the sum of fifteen dollars as liquidated damages for each day's delay after the expiration of such period, until the final acceptance of the work by the Architect and its delivery to the Owner.

The Site. Put a tight board fence 5 feet high, with three 2-inch by 4-inch rails, and with 4-inch by 4-inch posts set 6 feet on centers which will protect adjoining property from encroachments during building operations.

On the street side, and in front of the spot to be occupied by the building on the Avenue, enclose such portion of the roadway as is permitted by the City building ordinance to be used in building operations, with such fence—also place such walks—as are required by such ordinance.

On the site is one oak tree, and in the street two elm trees. These are to be protected by tree boxes of 2-inch plank and 2-inch by 4-inch cleats, with such holes cut on sides as will permit a full circulation of air about the trunk; and under no circumstances are any guy ropes to be secured to, or allowed to interfere with, any portion of the trees.

There will be no attempt to save any of the sod or shrubs now on the site, and the Contractor will be allowed all the space for piling material, etc.

Excavation. Four test-pits have been dug to a point 1 foot below the bottom of all footings; and bidders should visit the site and examine the conditions. The black soil which constitutes the top stratum is all to be piled on the lot wherever the Contractor desires, so long as it is not against the oak tree. Below the black soil is a stratum of sand which is satisfactory for concrete and cement mortar; below this is coarse gravel which may be used for concrete, provided all stones which will not pass through a 2-inch ring are cracked to such size. Any other material to be taken from the excavation is worthless, and must be hauled away.

The excavation is to be carried on so that different strata will be kept in separate piles. Any materials mixed so as to make it undesirable in the opinion of the Architect to use them for the purposes above designated, are to be hauled away.

The curbstone in place is to be protected so that there will be no settlement or shifting before the supporting wall is completed, by sheet piling driven down just back of the inside of curb line.

The other sides of the excavations will be sloped enough to prevent caving.

The excavation will not go below the party wall of adjoining building.

All excavation for footings must be complete before any footings are placed.

Backfilling. After all foundation walls are completed and thoroughly set, backfilling is to be done with sand or gravel.

Sewer and Water Connections. The sewer and water have already been brought on to the site. The sewer terminates at a brick manhole, 3 feet 6 inches inside diameter, with iron cover at grade about 5 feet from the side line of the building; and temporary connections with this manhole are to be made, so that there shall be at no time any standing water in the excavation, should it develop that the gravel is a water-bearing stratum.

The water connections will be encountered in making the wall at the curb line, about 4 feet below grade.

MASONRY MATERIALS

Cement. All cement required is to be Portland cement of such fineness that 90 per cent will pass through a 100-mesh sieve. The initial set shall be in not less than 30 minutes; and pats of neat cement about 3 inches in diameter and half an inch thick in center, worked off to a thin edge, exposed in air or immersed in water for seven days, after the cement has set sufficiently not to be disintegrated by water, shall show no discoloration, warping, checks, or signs of disintegration.

Sand. The sand shown to be on the site by the test-pits is of sufficiently good quality for all masonry mortar except wearing surface of pavements, steps, etc. Should there not be enough thus obtained, that brought in must be as clean and sharp as that found in excavating.

The sand for all wearing surfaces (down at least ½ inch), such as walks, steps, and cellar and area floors, is to be crushed granite, ranging from the finest material to that which will pass a 30-mesh sieve.

Broken Stone. The gravel stratum may be used for concrete aggregate, provided the sand and all stone too large to pass a 2-inch ring are screened out. The sand may be used with other sand on the site, and the stone screened out be broken to size required; the other material needed will be equal to that obtained on the site, and the Contractor will not dig holes below the finished grade lines to obtain material.

Brick. All *common* brick are to be run of the kiln, excluding all salmon brick which will take up during one hour's immersion in water as much as 18 per cent of their weight in water. As delivered, the hardest are to be kept in piles for use in backing exterior walls and flues; the softer are to be put in interior walls.

All *facing* brick are to be light color, of rough face texture; evenness of tone or burning will not be required; and the light and dark tones will be laid together, with no attempt to keep the same tones together; but no brick will be allowed which is soft enough to absorb over 12 per cent of its weight in water. The facing brick are to have full, square edges free from chipped corners.

Granite. All granite (the exterior wall below water table, and front steps and buttresses, are to be of granite) is to be of light color, free from black knots, and is to be finished 4-cut work. The joints are to be $\frac{3}{8}$ inch wide, and tooled back full for 1 inch from exterior surface; and the stones may be as thin as economical dressing will permit.

Soft Stone. From water table up to line of second story window-sills, all stone required is to be a light limestone or sandstone with a 4-bat-to-the-inch finish (consisting of 4 concave grooves to each inch, made either by hand or by machine), for all vertical surfaces. All other surfaces will be rubbed. The stone must be of an even texture, free from seams or streaks. Should any material used show in a rubbed block any grain from which the natural bed can be determined, it is to be set so that it will rest on its natural bed; but if the stone is of such character as to show no such indications, it will be immaterial whether it rests on its natural bed.

The ashlar may be as thin as 4 inches, except where reveals or corners occur. At reveals the heads are to be the full depth; and no vertical joint in the face of the wall is to be nearer the reveal than 1 foot, while all caps and sills are to be the full depth.

Terra-cotta. *Structural.* The interior faces of all exterior brick walls are to be furred with 2-inch porous terra-cotta of such quality that a nail can be driven therein without splitting and be firmly held.

All flues are to be lined with hard-burned non-porous flue linings at least $\frac{3}{4}$ inch thick.

Terra-cotta. *Ornamental.* (*Cornice and Balustrade*). All ornamental terra-cotta is to have a color similar to the lighter tones of brick, with a combed surface forming about 6 ribs to one inch. It is to be hard-burned, with capacity to absorb not over 4 per cent of its weight of water after immersion for one hour. All approximately horizontal surfaces are to be made rough, to key the cement coat which it is proposed to put above. The finished pieces are to be straight and unwarped, and in lengths never less than 2 feet 10 inches for continuous members; in projecting members, all vertical joints must occur over bearings. All members with less than 2-feet face must be in one piece. The Contractor must furnish shop drawings for approval of jointing only; no outlines are to be modified thereby, and such changes in the jointings may be made, within the lines above laid down, as in the judgment of the Architect will better the construction or appearance of the work.

MASONRY CONSTRUCTION

Concrete. The concrete work of all footings and exterior foundation walls below grade, will be composed of 1 part Portland cement, 4 parts sand, and 7 parts screened gravel or broken stone. In order to make these proportions efficient, it will be necessary, in mixing and applying the materials, to use great care. The Contractor, under direction of the Architect, will construct a cube about 18 inches square, of the mixture, to show its possibilities when carefully manipulated; this standard will be the one by which the work will be judged, and any portion of the concrete work which falls below this standard will be condemned. The sand and cement must first be thoroughly mixed dry, turning over at least four times, if no machine is employed, so that no uncolored particles of sand can be detected; after which, just enough water is to be added to dampen the mass thoroughly. The aggregate is then to be mixed in, wet.

It will be necessary to place plank forms for all footings and walls; and the concrete is to be placed in such forms, and thoroughly rammed. A smooth surface like a spade is to be forced down, just inside the planking, to force the aggregate back from both faces of the wall until clear mortar will only show. The walls of each portion are to be carried up the full height rapidly, and the planking to be so arranged that it can be removed from any part within two days after the placing of the concrete. Both faces of the wall are to be finished smooth with a trowel, the surface being so compressed as to make it proof against ground moisture.

Basement Floor. After the lining of the first floor is laid, the basement floor is to be put in. On the base of concrete 3 inches thick, composed as for footings, before it has set, put a wearing surface ½ inch thick, composed of 1 part cement to 3 parts crushed granite, troweled to a smooth, level surface.

Reinforced concrete beams and slab over sidewalk coal-cellar, are to be composed of 1 part Portland cement, 3 parts sand, and 5 parts gravel or broken stone which will pass through a ¾-inch ring. This is to be tamped in the forms and around the reinforcing metal, to form a solid, compact mass. As the strength of this slab is dependent principally on the care in mixing the material and in placing it, it must be tested three weeks after it is set, by placing five layers of brick over the entire surface. If under this test it fails or cracks, it is to be removed and replaced at the Contractor's expense.

After the completion of the building, a sidewalk in all respects matching that now in place is to be continued over the concrete slab, and the iron coal-hole cover-frame is to be built in so as to set flush with the surface.

Brick Masonry. Rough brick partition walls in basement, and all chimneys and the backing of all exterior walls, will be laid and thoroughly embedded in Portland cement mortar, 1 part cement to 4 parts sand; and all brick are to be thoroughly drenched before being laid. In backing up stone work, the brick is to be so bonded that it can be brought up approximately level with the top of each stone course; and there is to be placed in every horizontal stone joint a sheet of No. 24 expanded metal, extending to within 1 inch of the face of the stone and through the full thickness of the brick wall. This is to be free from rust, and at once embedded in the mortar joints of stone and brick to form a reinforced concrete bond.

Every fifth course of rough brick is to be of headers.

Where rough brick walls will be exposed to view, the joints will be trowel-pointed and all mortar kept off the face.

At the base of ash-pits, set doors 8 inches by 12 inches.

At the base of chimney flues, set doors 6 inches by 8 inches.

In each fireplace hearth, there is to be a small ash-dump, constructed entirely of cast iron, with cast-iron frames built in and anchored.

Terra-cotta pipe thimbles are to be built in, 1 foot from the finished ceilings, as follows:

1—8-inch thimble in Heater Cellar,
1—6-inch thimble in Laundry,
1—6-inch thimble in Kitchen.

The fireplaces are to be built complete with fire-brick backs and facings, all laid flat, as the chimney is constructed. Special-shaped firebrick, with ends moulded so as to conform to the line of the facing and bevel of the jambs, are to be used at the angles between facing and jambs.

All brick below the flat arch are to be laid in fire clay with close joints; and in each joint a strip of No. 24 expanded metal is to be built, extending within ½ inch of the face of the brick and leaving at least 4 inches to build into the mortar joint of backing. In the throat, put cast-iron flue-stops, with dampers which can easily be closed from below.

The flat arches *above* are to be laid in Portland cement mortar, with No. 24 expanded metal extending through each joint to within ½ inch of exposed faces and sticking up 4 inches. When this is complete, a reinforced concrete beam is to be formed above, in which the brick ties are to be embedded in addition to 6 strands of No. 8 twisted wire fencing.

The flue linings of hard terra-cotta are to be set close; and any which are crooked or broken in handling will be rejected.

Face Brick. Face brick will be used for the visible surfaces of the exterior brick walls and chimneys. Each course will alternate headers and stretchers, and the facing and backing are to be carried up together and of such size brick that the headers of every fifth course will bond. The header of all other courses may be half-brick. The joints will be approximately ½ inch thick, and trowel-pointed as the work is laid; and all mortar must be kept off the face.

Over the windows, flat arches are to be formed, bonded, as required for the fireplaces, to the concrete beam formed back of the arch.

Setting of Granite and Soft Stone. The joints are to be ⅜ inch thick, with expanded metal as required above therein, the mortar to be of the same composition as for brick.

The contractor will be responsible for any staining of the faces of the stone. He will be permitted to use such brand of cement as he may consider safe, provided in the tests it conforms to the requirements of Portland cement as stated under "Cement."

NOTE TO STUDENT. No. 1.—In order that the student may ascertain to what extent he is grasping the situation, at this point, and before proceeding further with this specification, he should spend at least six hours on masonry work in progress in his vicinity, observing work which corresponds to that referred to in this outline specification. He should ask questions of such foremen or workmen as he is able to approach, regarding the details of construction and materials used. He should see the men who furnish the material, and obtain from them the prices, and also find if there are different grades thereof.

Under no circumstances are notes to be taken. The student is to get the information in mind in such a way that he will *remember it.* After the conclusion of these investigations, he should allow four days to elapse, during which time he is to think over the situation as observed. After the four days of *thinking,* he should write a specification not exceeding 400 words in length, covering some portion of the work or materials observed, and giving special attention to covering the most ground possible with the 400 words.

Setting Terra-cotta—Structural. All furring terra-cotta is to be set in Portland cement mortar. As 1 to 4 mixture would be too short for the thin edges, the mortar will be 1 cement to 2½ sand; and one 30d-spike is to be driven into the brick mortar joints, with head projecting 1½ inches into furring joint for tie.

Ornamental Terra-cotta. All joints are to be ½ inch thick; and the special anchors shown on the detail are to be built in. Fill all hollow portions with concrete formed by filling in with cement mortar and then crowding in broken bricks until the mortar is forced into every corner.

Over all approximately horizontal surfaces, put a ½-inch coat of Portland cement mortar, 1 part cement to 1 part sand, after covering the surface with a continuous sheet of No. 24 expanded metal. The terra-cotta surface is to be thoroughly wet, the mortar coat pressed vigorously through the metal, and the surface finished smooth. This surface it to be protected from the sun for four days, and wet at such intervals as will keep it at all times moist.

CARPENTER WORK

Materials.—*Rough Lumber.* All wood which is not exposed to view in rooms above basement, may be of pine, spruce, or hemlock, sized and seasoned.

Joists and Stringers. Joists and stair stringers must be sound, with no loose knots or knots over 2½ inches measured the longest way within 3 inches of the lower or within 1 inch of the upper edge.

Studs. Studs must be sound, with no loose knots in either edge.

Miscellaneous framing lumber, bridging, etc., must be sound.

There will be no wood floors in basement. Cover all joists and rafters with tongued and grooved pine or spruce boards ⅞ inch thick and not over 5 inches wide, for lining. Shakes and other imperfections will be accepted, which do not leave holes, provided the imperfection is of such a character that it will firmly hold a nail.

All finished floors of first and second stories will be of quartered white oak; and all floors above will be of edge-grain pine, all tongued and grooved and not over 2½ inches face, thoroughly kiln-dried, of a quality free from shakes. Sound knots will be allowed; also imperfections which do not extend to within ¼ inch of the wearing surface.

All miscellaneous lumber for grounds, window-frames, etc., may be of pine or spruce, with square edges and free from loose knots.

There will be no finish in basement, except door-frames and doors, which will be stock pattern and paneled 1¾ inches thick.

The finishing lumber for all rooms on first floor except kitchen, pantries, and closets, will be of quartered white oak, with bright surface, and with no imperfections which appear on the face or exposed edges; but sound knots of any size, which are finished smooth, will be allowed. All other finishing lumber of first and second floors is to be of oak, ash, or birch, of a quality specified above, but may be straight-sawed.

All finishing lumber above second floor is to be of pine, of a quality containing no defects which one coat of shellac and three coats of paint will not cover.

All shelving in closets and pantries throughout the building, may be of pine or poplar, full ⅞ inch thick.

All stair treads, rails, balusters, and risers are to be of quartered white oak, the treads to be 1⅛ inches thick, all strings to be of the same wood as the finish of adjoining floors.

CARPENTRY CONSTRUCTION

All *joists* are to be set 1 foot 4 inches on centers with a bearing on all supporting walls of 4 inches. When in brick walls, the ends are to be beveled so that the upper edge is just on a line with the inside face of brick wall.

All *trimmers* are to be doubled, and all *headers* over 10 feet long are to be tripled. Where joists are framed together, no cutting is to be done; but wrought-iron hangers or stirrups with a cross-section of all vertical parts equal to 1 square inch of metal, are to be used.

Every third joist in the brick wall is to be anchored thereto by a strap anchor containing ½ square inch of metal, extending 2 feet onto the lower edge of joist and within 4 inches of the outside face of wall, with end turned up 2 inches, to be spiked to the joist with five 30d nails to each anchor. Where joists meet over partition heads, they are to be spiked thereto with four 20d spikes at each bearing, and, when practicable, to the joist of the opposite side. All joists are to be cross-bridged every 8 feet of clear span, with 2 by 2-inch stuff, with two 12d nails in each end.

Studs are to be 1 foot 4 inches on centers, both studs and heads doubled beside and over all openings; and all openings over 4 feet wide are to be trussed above. Each stud is to be secured with four 12d nails at each end, and to have one line of 2 by 2-inch single bridging in the height of each story, this bridging to be so set in the center of the stud that it will be an inch back from both faces.

The *lining floors* will have two 8d nails in each board over each bearing, one in the tongue and one about 1 inch from the groove edge. All lining will be so laid as to be perfectly tight, and may be laid before plastering.

All *sash* will be of pine, 1¾ inches thick. When only single sash are shown, they are to be hinged with three 3-inch wrought-iron butts at the top, with two hooks to each sash to secure them when either closed or open. All other sash are to be double-hung with braided cotton cord and iron weights, the pockets of the window-frames to be as long as practicable.

All *finished floors* will have one 8d nail over each joist; and, after laying, they are to be scraped or planed to an even surface. These floors are to be laid after all other finish is in, and are to be cut with great care against the base.

All *finish lumber* is to be put up in such a manner that the nails or screws securing it will be invisible. This is to be done by working through the back or in quirks or concealed places, but no splintering to hide the heads of nails will be required.

The hardwood *doors* will be veneered on soft white pine cores made of strips not over ⅞ inch thick. Before the veneering is put on, the Architect is to be advised where the cores may be inspected; and, if the gluing or seasoning is defective, or hard knots are discovered, the cores will be rejected. The panels are to be left free to shrink.

All doors below third floor are to be 1¾ inches thick; all on third floor and above, 1⅜ inches thick.

The *mantels* are to be built up complete, all parts glued together and nailed or screwed in concealed places, and brought to the building ready to set in place.

Hardware. The owner will furnish mortise locks complete, 3 butts for each door, 2 sash lifts, 1 sash lock, 1 socket, and 4 sash pulleys for each window.

The contractor is to set these and to furnish and set any other hardware evidently necessary to complete the work—such as wrought-iron brackets for shelves, sliding-door hangers, etc.

Roof. The flat portions of the roof are to be covered with canvas. The steep portions will be covered with tile.

Canvas. All canvas must weigh, when thoroughly dry, 10 ounces to the square yard, and must not lose over 5 per cent of its dry weight after being soaked in water 10 hours and so rubbed as to take out all matter soluble in water. It is to be laid dry, stretched tight, all edges to be lapped 1 inch and tacked with ¾-inch tacks set ¾ inch apart.

In all places where the roof meets a vertical surface, three-cornered strips 1½ inches by 1½ inches are to be nailed, and the canvas is to be carried up over them and 8 inches on the vertical wall. If such wall is of masonry, there will be a 1⅛ inch by 2½ inch dressed strip bolted by expansion bolts set 3 feet apart under the projecting ledge of brick; and canvas is to be tacked to the under side of this strip as at other places.

After the entire roof is covered and the canvas swept clean, it is to be soaked with water, and, when thoroughly wet, is to be rubbed full of stiff paint composed of white lead and raw oil in proportions of 100 pounds of lead to 3½ gallons of oil. After this is dry and the surface hard, and not less than five days after the first application, the roof and all exposed surfaces of wood strips in connection therewith are to have two coats of white lead and oil paint.

Tile. The steep portions of the roof are to be covered with red tile burned from a tough clay; and all nails or wire necessary to secure them permanently to the roof are to be of copper. If wire is used, the gauge is to be not less than No. 12; if nails, the gauge is to be not less than No. 8.

All joints are to be so close that there will be no necessity for water proof paper below, or for cement, except at the hips.

All valleys are to be open, and flashed with 14-ounce copper, which *must* extend not less than 8 inches under the tile at each side.

NOTE TO STUDENT. No. 2.—See Note No. 1, on page 33, relative to examination of actual masonry work. At this point the student is to follow the directions in No. 1, but applying them to carpentry work and materials, and to write a specification (not exceeding 400 words) of some portion as directed in Note No. 1.

Gutters and Conductors. All gutters and exterior conductor pipes will be of 16-ounce copper; and where they join the soil pipe system, they are to be soldered to cast brass thimbles, which are to be calked into the iron piping with pig lead.

Plastering. There will be no plastering in basement; but all the walls above are to be finished with 3-coat work. All brick walls are furred with terra-cotta, on which the plaster is to be placed. All other surfaces are to be lathed with pine or spruce lath only partially seasoned; and wherever these lathed partitions and the brickwork of chimneys or the terra-cotta adjoin, expanded-metal or wire-mesh lath are to be placed, extending 8 inches onto each side; and, as each coat of plaster is placed, all corners are to be cut through from floor to ceiling.

All plasterers' material is to be freshly burned stone lime, slaked at least two weeks before mixing with sand; and to contain hair of the ordinary quality sold for plastering purposes, and sand clean and sharp. The mixing is to be done just prior to its use, and is to be thorough. The hair is to be soaked so as to separate it from matting, and enough used, and so mixed that it will not be possible to find any small portions of the mortar in which the hair is not visible.

The first coat is to be mixed very rich with lime, using not more than four volumes of sand to one of unslaked lime; and is to be scratched.

The second is to be a thin coat, in which six volumes of sand may be used to one part of unslaked lime; and this is not to be applied before the first coat is dry and hard.

The last coat in all cases will be white; hard finish of lime putty gauged with plaster of Paris. This is to be applied in not less than five days after the first coats appear dry and hard.

The first two coats are to go to the floor back of all base-boards and wainscot, and be brought up to all grounds.

When completed, the work is to be straight and free from discolorations, hair cracks, or lime pits.

NOTE TO STUDENT. No. 3.—See Note No. 1 on page 33, relative to examination of actual masonry work. At this point the student is to follow the directions in No. 1, but applying them to plaster work and materials, and to prepare a 400-word specification of a portion of the work or materials, as explained.

Paint. All exterior woodwork is to be primed as soon as in place, with raw linseed oil and a very small amount of yellow ocher; and later to have two additional coats of raw linseed and white lead paint mixed in the proportion of 100 pounds of lead to 5 gallons of oil, colored with such pigments as will produce the single color desired, and having no more drier in each coat than is necessary to insure its drying within 18 hours.

All pine woodwork throughout the house, including floors, will have one coat of white shellac and three coats of paint, mixed as above and of the colors selected by the Architect. There will be one color only in each room for finish, and one for floors.

All hardwood except floors is to be filled with a mineral filler, and to have three coats of varnish, the last two rubbed to a dull surface. The varnish is to be of a brand covered by an affidavit from the manufacturers that it contains no rosin or petroleum products and that it contains at least 17 per cent of copal gums. Also, the varnish must be of such character that a film on glass will not dry in less than 48 hours; and when dry, the film is not to be brittle. Four days must elapse between the application of each coat of varnish and the succeeding coat.

All hardwood floors, treads, and risers are to have one coat of hot raw linseed oil and two additional coats of cold raw linseed oil, three days to intervene between each coat and the next.

Glass. All glass is to be at least ⅛ inch thick and free from all smoke, bubbles, or wavy lines. It is to be set in the sash after priming with white lead, back-puttied, and fastened with points not over 6 inches apart and full-puttied.

PLUMBING

Fixtures. The *bathtubs* are to be cast iron, with roll rim and standing waste, enameled on the inside and over the roll, the outside finished with 3 coats of white lead and oil paint and one coat of outside varnish.

The *washtrays* and *sinks* are to be of similar material and finish, the sinks to have overflow cast in side; and both are to stand on galvanized-iron legs.

The *washbowls* are to be oval, not less than fourteen by seventeen inches, of one-piece earthenware, with standing waste and nickel-plated legs.

The *waterclosets* are to be of the siphon-jet type, with bowl and trap all cast in one piece, with hardwood seat and cover bolted to the bowl, and with copper-lined oak tank of 10 gallons' capacity.

The *hot-water boiler* will be of galvanized-iron of 60 gallons' capacity, tested to 150 pounds' pressure and connected to the water-front of range.

All enameled iron work is to carry the guarantee of manufacturer against cracking or crazing of enamel for two years.

All earthenware must carry a similar guarantee against crazing for two years; and the guarantee in each case must provide that, in case the fixtures do not hold out for the period in perfect condition as regards the points covered, the manufacturers will pay all expenses incident to furnishing new ones in place, on which they are to place a similar guarantee.

All paint and varnish used are to be of qualities specified under "Painting."

All *water piping* is to be of lead, of the weights known to the trade as "Extra Heavy," except in basement, where it is to be of galvanized iron.

From the end of the water main now at the front wall, extend a 1¼-inch pipe to where the lead riser leaves the first floor-level, this riser to be 1 inch and to extend to the ceiling of the upper floor.

The branch to the basement washtrays is to be ¾ inch; and that to the water-closet, ⅜ inch, from the 1¼-inch main.

Above the basement, branches to sinks and water-closet tanks are to be ½ inch; to bathtubs and hot-water boiler ¾ inch; and to washbowls, ⅜ inch.

Hot water from the boiler at kitchen range is to be carried to all fixtures except water-closets, in pipes similar in all respects to those above referred to.

All lead pipes are to be run on hardwood boards and through floor-boxes, and to have tacks not over 2 feet 6 inches apart; and where run horizontally, there are to be two brass bands between each pair of tacks, to prevent sagging.

No turn is to be made on a circle of less than 9 inches diameter; and pipes are to be carried so as to provide a dead end of not less than 3 feet above the highest branch, and so graded that all will drain through a stop and waste-cock to be set just inside the basement wall.

There are to be as few joints as possible in the lead piping; but where they occur, either in connection with lead or brass, the joints are to be wiped; and, if connections are necessary to iron pipes, brass ferrules either calked or screwed into the iron pipe are to be used.

Just inside the basement wall, and wherever a branch leaves the main in both hot and cold-water lines, place stop and waste-cocks with waterway of equal area to the pipe in which it is placed, and with ¼-inch wastes to waste pipes or sewer. Those in the cellar are to be plain brass; and those above, nickel-plated, with lever handles.

All faucets except for bathtubs are to be self-closing, of ⅛-inch larger waterway than the pipe supplying them, those in the wash-trays and sinks to be plain brass, those for bowls to be low down nickel-plated.

The bathtubs will be equipped with combination, compression bibbs closing with the pressure, of the plainest and heaviest stock pattern, with nozzle to which a ½-inch hose can be attached.

Traps. Under the set of tubs, each sink, and bathtub, set a 4-inch lead pot trap 8 inches deep, with 4-inch brass trap-screw in the top, set in an accessible place as near the fixture as possible.

Under each bowl set a nickel-plated trap which cannot be siphoned under any conditions existing in the building, and with no movable parts, but with trap-screw which will permit its being cleaned.

Soil Pipe. All soil pipe and fittings are to be of cast iron of the grade known to the trade as "Extra Heavy"—that is, the grade in which a 5-foot length of 4-inch pipe weighs not less than 65 pounds, coated outside and inside with asphalt paint. The main line extending from the running trap now in manhole to a point just above the highest fixture, is to be 4-inch; all branches to fixtures are to be of the smallest diameter allowed by the city ordinances, and are to be brought to points as near the fixtures as possible.

Above the highest fixture, a 4-inch wrought-iron fitting is to be calked into the cast-iron hub of soil pipe, and continue with 4-inch wrought-iron screw-jointed pipe into the flue for the kitchen range, and thence to top of chimney; but before the wrought pipe enters the flue, a right angle is to be formed in the screw-joint fittings, so that, in case of unequal settlement of any part, the screw-joint in the angle will take up the movement.

Back air or "vent" pipes are to be installed only as required to comply with the city ordinances.

All soil and waste pipes are to be calked with pig lead.

As the details show the location of pipes and fittings required on the plumbing drawings, they are not described here.

After all roughing-in of soil and waste pipe is complete, all outlets below the top are to be stopped, and the entire system is to be filled with water, which is to stand in the pipe without settlement for 10 hours.

All connections from bowls and sinks to traps and waste pipes are to be of 1-inch "Heavy" lead; from washtrays and bathtubs, the wastes are to be 1½ inch "Heavy" lead; and the joints are to be formed as indicated above for water runs.

The water-closets are to be set on and bolted to brass flanges above the floor, from which a 4-inch lead bend of 8-pound weight is to connect with a brass ferrule calked in the soil pipe.

The flush-pipe connection from tank to water-closet is to be nickel-plated brass 1¼-inch pipe.

In carrying out the entire plumbing system, all pipes are to be run exposed, except when soil pipe is continued in flue. There is to be no cutting of timbers; and wherever pipes pass through partitions or floors, collars of the same material as the pipe are to be placed, except that where lead pipes are used, the collars are to be of nickel-plated brass.

The requirements of the city ordinances are to be observed; while where this specification requires work or material in addition to that allowed by the ordinance, this requirement is not to be construed as relieving the Contractor from furnishing all that is herein specified; and when the work is completed, it must be in such condition that every fixture and pipe shall perform the functions pertaining thereto in a perfect manner. And, further, it shall be an obligation on the part of the Contractor to make the smoke and peppermint test of the entire system, when required, not less than 3 months after the occupancy of the premises; and previous to such tests, there is to be no tightening of unions or other screw-joints. Any joints which then are not found to be perfectly tight, are to be opened, and such washers or other appliances placed as in the opinion of the Architect will make a permanent seal.

NOTE TO STUDENT. No. 4.—See Note No. 1 on page 33, relative to examination of actual masonry work. At this point the student is to follow the directions in No. 1, but applying them to plumbing work and materials, and to prepare a 400-word specification of a portion of the work and materials, as explained

Gas Piping. Inasmuch as the Gas Company lays down full and complete rules governing the sizes of pipes and methods of running them, which must be followed, this portion of the work is not set forth here further than to require that such rules shall be followed. But in carrying out the work no joist is to be cut more than 1 inch deep, and never more than 8 inches from its bearing.

No vertical stud is to be cut more than 1¼ inches deep, and no vertical supporting timber or pier under any circumstances.

When complete, the system is to be tested, in addition to the Gas Company's test, with 15 pounds' air-pressure, which must be held for half an hour.

HEATING

The Owner will furnish, deliver, and set up in the cellar, but without any smoke- or steam-pipe connections, a cast-iron, sectional, low-pressure steam boiler; and the Contractor is to furnish and place all other necessary material and labor to install the system completely. All radiators are to be of cast iron. The piping is to be so installed that all steam and condensed water in the same pipe shall travel in the same direction, except that one short connection to radiators may let in steam and take out water, so that only one valve will be required.

All radiator valves are to have unions, so that the radiator can be completely disconnected thereby, and are to be nickel-plated, with wood handles.

The air-valves to radiators will be the ordinary type of hand valves.

All valves other than radiator valves in pipes will be gate valves allowing a full opening.

The sizes and positions of all radiators and pipes are shown on drawings Nos. 30, 31, 32, and 33.

The smoke pipe from the boiler is to be of No. 22 gauge black iron, with riveted joints.

After the system of steam pipes and radiators is complete, it is to be tested with air-pressure to 50 pounds; and the pressure is to stand one hour without showing any drop at the gauge.

All radiators are to be bronze-painted; and all pipes above basement are to be painted maroon, and all in basement black.

A brick wall is to be placed around the boiler, extending to the floor-lining between the joists, leaving a space of at least 2 feet between boiler and wall at all points except in front. Overhead, nail to the joists No. 24 galvanized-iron sheets, above which, between the joists, put 2 inches of mineral wool.

From the chamber thus formed, take IX tin pipes (that is, pipe of tin on iron or steel plates which weigh approximately 9 ounces to a square foot before coating with tin) to the registers indicated on the First-floor drawing. Each pipe is to have a damper completely closing the entire area. The registers are to have tight-fitting valves and cast-iron borders.

Place the cold-air box of No. 24 galvanized iron, with hinged valve closing the entire area, and with chain and weight competent to hold it in any desired position.

NOTE TO STUDENT. No. 5.—See Note No. 1 on page 33, relative to examination of actual masonry work. At this point the student is to follow the directions in No. 1, but applying them to heating apparatus, etc., and to prepare a 400-word specification of a part of the apparatus.

Cleaning up. After the practical completion of the work, all surplus material and débris is to be removed from the premises; the building swept clean; windows washed; and the finish wiped off, so as to allow a final inspection of all visible points. Any items which are then passed as satisfactory shall be considered as fully complying with the contract requirements unless there later appear hidden defects which at that time could not be seen.

PROPOSAL SHEET

..................the undersigned hereby proposes to construct a dwelling for.................. ....
in strict accordance with drawings numbered ....
and the foregoing specifications for the sum of.........................
.... $................

If light colored sand stone or lime stone is substituted for all face brick and ornamental terra-cotta following the same outlines, add - - - - - - $...............

If two months more time is allowed for the construction deduct - - - - - - - - - - $...............

If in the upper stories plain oak is substituted for painted pine add - - - - - - - - $................

Signed...

THE FORMAL CONTRACT

After the completion of the drawings and specifications, it is customary to award a contract—*i.e.*, to enter into an agreement for carrying out the work; and an instrument is drawn for the signature of both the Owner and the Contractor, setting forth their legal relations. Inasmuch as a contract between two parties is an agreement to do a certain specific thing, it is evident that the principal part of the contract, or the basis therefor, consists of the drawings and specification, in which is the full and complete description of the specific thing to be done. Hence, in the preceding text, the point that every requirement and condition should be clearly set forth, has been emphasized; for, however strongly the formal contract is drawn, if it has no specific basis, it is of no value. Therefore, from a legal standpoint, emphasis is again placed on the necessity for a clear and unambiguous statement in the specification, of just what is to be done.

The *formal contract* is not drawn till after the award of the work; but separation in time does not change the fact that it is only a continuation of the *specification*; it is its completion, and it should in short, clear terms set forth the final arrangement.

As the province of the specification is to set forth and explain what is not included in the province of the drawings, the formal contract is to set forth such final conditions as the specification was not able to cover.

There are certain conditions likely to prevail in carrying out the work, which may in a very material way affect the operation of the contract, and possibly destroy its force notwithstanding the fact that its basis is sound. As the contract is an agreement to do a certain specific thing, it follows that, if any change is made in any of the matter which goes to make up that specific thing so that some other specific thing is substituted, the terms of the contract are not filled, and such changes, unless properly guarded, can be made the basis of refusal on the part of either the Owner or the Builder to abide by all the conditions covered by the contract. Questions of this description are among the most serious which arise in general architectural practice.

As buildings progress, the Owner and often the Architect see items which, if changed, would improve the result; and as the departure from the specific thing contracted for appears slight, the Builder is in a general way either requested or directed to make the change. Also, in the progress of the work, the Builder often finds it possible for him to make better arrangements for materials, etc., by making substitution, and, considering the change of little moment, proceeds to make it.

In the first of the above cases, the Owner or the Architect is surprised when he finds that modifications made by either are the basis for an extra charge of some magnitude, and that it is also used as an excuse (and it is generally valid) for several days' delay in the completion of the work.

In the second case, the Builder is surprised to find his substitution the basis of a demand that he make a material deduction from the contract price.

In either case, the Architect is blamed by both parties—and often justly so—for allowing matters to drift into the existing conditions; and it is not unusual for the Owner and Builder to get together and settle their differences, without changing their opinion of the Architect.

Therefore, after the signing of the contract, it should be the special province of the Architect to see that as few changes as possible are made; and, when it is advisable to make changes, to see also that all the conditions affected thereby are fully understood, and that such understanding is expressed in writing signed by both parties.

It is not the intention of the above to intimate that desirable changes should be abandoned in order to avoid complicating the contract situation, because there is no work in which improvements cannot be made as it progresses; but emphasis is laid on the suggestion that such changes should be as few as possible, and should never be allowed at all unless there is a distinct advantage gained to the *Owner*, and that, in consenting to any changes, the case should be put in such formal shape that there can be no later misunderstanding.

As the question of time is generally important to the Owner, the Architect should see that all details are furnished within the specified time, as it is unreasonable to expect the Builder to complete the work on time if he is delayed in the receipt of his drawings. Such delay is generally a sufficient excuse for extension of the contract time for completing the work. Special care should be taken that the modification on the details be not of such a character as can be used as a basis for demands for extra compensation beyond contract prices

Under ordinary conditions such as prevail in private practice in work of not large magnitude, a simple document is all that is necessary to set forth the final relations of Owner and Builder, in form somewhat as follows:

FORM OF AGREEMENT BETWEEN OWNER AND BUILDER.

AN AGREEMENT entered into this 15th day of September, 1907, by and between...................., of Chicago, Owner, party of the first part, and...................., also of Chicago, Builder, party of the second part:

WITNESSETH: That the said party of the second part, for and in consideration of the sum of Five Thousand (5,000) Dollars, in payments as set forth in the specification, agrees to construct a city dwelling for the said party of the first part, at the corner of..........Ave. and...........St., City of Chicago, in accordance with drawings numbered.............and specifications all prepared therefor by..................Architect.

Which drawings and specifications are a part of and the basis of this agreement.

In CONSIDERATION of the foregoing, the said party of the first part agrees to pay to the said party of the second part the full sum of Five Thousand (5,000) Dollars, in payments and under conditions as fully set forth in the specification.

In witness of the foregoing, the parties aforesaid here set their hands and seals to this and one other instrument of like tenor and date, this........ day of.........., 1907.

...................., Owner (Seal).
...................., Builder (Seal).

In presence of:
....

Should changes be necessary, a supplementary agreement in the following form should be prepared for the signature of both parties:

WHEREAS: ...., Owner, did, on the Fifteenth day of September, 1907, enter into an agreement with...................., Builder, for the erection of a dwelling in accordance with drawings and specification prepared therefor by...................., Architect, as fully set forth in such agreement; and

WHEREAS: it is the desire of said...................., Owner, to make certain changes as fully set forth as follows:

....
....

The said...................., Builder, agrees to make such changes and make all necessary modifications in the work necessarily incident thereto, for the sum of One Hundred (100) Dollars, as an addition to the original contract price for the work, it being understood that no additional time is to be required in the completion of the work on account of these changes.

And the said...................., Owner, agrees to pay the additional sum of One Hundred (100) Dollars on account of these changes.

In witness of the foregoing, the parties above said have set their hands and seals to this and one other instrument of like tenor and date this........ day of............, 1907.

......................., Owner. (Seal).
......................., Builder. (Seal).

In presence of:
....
....

The above agreement has been duly noted by me,
...................., Architect.

As the work progresses, it will be necessary for the Architect each month to make an estimate of the value of the labor and materials satisfactorily in place, and to issue to the Contractor a certificate for presentation to the Owner. A certificate drawn along the following lines not only serves its purpose of notifying the Owner of the amount due, but also furnishes him with a statement of the account to date. It is very desirable that both Owner and Contractor shall each month see, understand, and sign a clear statement of the conditions existing under the contract; for this closes up all matters which if allowed to drift, might cause serious misunderstanding.

Certificate No. 2.

Chicago, Illinois.
November 1, 1907.

This certifies that...................., Contractor, under his agreement, dated September 15, 1907, with...................., to construct a dwelling at the corner of .... Ave. and............. St., City of Chicago, is entitled to a payment in amount Twelve Hundred Dollars ($1,200.00) under the terms of said agreement in accordance with the following statement of the account:

Contract price		$ 5,000.00	
Extra No. 1, dated October 3		100.00	
Extra No. 2, dated October 18		125.00	
Total of contract and extras to date			$ 5,225.00
Value of work and materials satisfactorily in place at this date		$ 2,400.00	
Retained percentage 10%	$ 240.00		
Certificate No. 1, Oct. 1, 1907	960.00		
Certificate No. 2, Nov. 1, 1907	1,200.00		
Total value of work in place on this date			$ 2,400.00
Total balance unpaid under this contract			$ 2,825.00

To...................., Owner. ...., Architect.

November 3, 1907.

Received from...................., Owner, the sum of Twelve Hundred Dollars ($1,200.00), and I acknowledge that the above statement of the account is complete and correct.

...................., Contractor.

RECEIPT FOR INSURANCE POLICIES.

(To be detached and delivered to Contractor after signing.)

Received of...................., Contractor, fire insurance policies as follows: ...., in total amount $2,600.00, issued as required by agreement dated September 15, 1907, for the erection of a dwelling for me at the corner of..........Ave. and..............St.

...................., Owner.

In all the foregoing relative to formal contracts, consideration has been given only to such cases as would come up in an ordinary private practice, where it is taken for granted that the relations of parties with one another are such that all that is necessary to insure a satisfactory completion of all agreements is a definite understanding of exactly what is to be furnished and done by each of the contracting parties. No contracts can be drawn, or specifications written, which prevent either party from bringing suit against anybody if they so desire.

The question is entirely different in the case of formal contracts for public or corporation work requiring bonds, where, on account of the impersonal nature of the Owner, it is impossible to adapt procedure to the varying conditions that arise. It is entirely outside the province of the Architect to attempt to arrange details of a legal nature in such cases. The liability of a bondsman is very peculiar, and he can be relieved therefrom because of even very small departures from the agreement. Thus changes in the work or material, changes in the dates or manner of payment, changes in time of completion, etc., can be set up (and generally with success) as reasons why obligations under the bond should be set aside.

As a general thing, bonds are now furnished by large corporations who employ the best of legal talent to dispute, on any ground, their liability should they be called on; and it is unreasonable for an Architect to attempt to protect his patron's interest under such circumstances. Therefore, in cases of this nature, the Attorney representing the public body or the corporation for which the work is to be done, should draw the formal contract and bond, and supervise their execution. Any action during the progress of the work which could in any way affect the specific obligations of either party, should be passed on by such Attorney; and, in case of any change, he will obtain a formal consent of the sureties on the bond, before its final ratification.

GOVERNMENT CONTRACTS

It is not generally known to what an extent the Treasury Department of the United States is a builder, or to what extent its demands for material and labor influence the market; nor do many contractors or material men know much about the nature of the contracts to be awarded, and there is a kind of superstition that such contracts are so bound up in "red tape" that it is wise for contractors and men with good material to keep out of this market. It is the object of this paper to show the amount of work which is under the control of the Treasury Department; to indicate its general nature and the conditions under which contracts are let and the work executed, and which govern the furnishing of materials; and to explain the nature of the formal contract and in what respects it differs from those usually required between individuals.

Government work is not all red tape. In fact, when the reasons for certain fixed lines of action are understood, the red tape appears in the light of necessary business machinery, which, if more frequently applied with discretion to private enterprises, would assist in producing results far in advance of the average now obtained.

Number and Value of Buildings Now under Way and Contemplated in the Near Future. There are now (January, 1907) under contract, wholly or in part, or for which contracts will probably be awarded within two years, approximately 250 buildings, the cost limit of which, including sites, has been fixed by Congress at approximately $40,000,000. Placing the cost of sites at about 20 per cent of the limit of cost, it will appear that there is to be spent in material and labor over $30,000,000. At the rate at which work is generally carried on, the disbursements involved through the different channels will be from $600,000 to $1,000,000 *a month.* While there are many corporations in the world disbursing an equal sum for materials and labor required in industrial enterprises, there is probably none where such large sums are disbursed through general channels open to so many branches of industry.

Character of Buildings. The buildings under the control of the Treasury Department are for the use of the civil branches of the Government, such as Postoffices, Courts, Customs, Internal Revenue, Marine Hospitals, and Quarantine Stations. Such buildings as the Capitol, the Library of Congress, and the Executive buildings of the different Departments at Washington, are not under the control of the Treasury Department nor built by it; neither are forts or other Army or Navy buildings, or United States Jails.

Many of the buildings under the Treasury Department are very large and expensive, the New York Custom House and the Chicago and San Francisco Postoffices being buildings of this type. The larger number, however, are of moderate size, ranging from 40 feet by 80 feet outside dimensions, and one story high, to buildings of three times that area and three stories high, and costing complete, with heating apparatus, etc., from $35,000 to $175,000 each.

The large majority are of fireproof construction and classic design, with interior finish of hardwood and marble where the funds will permit. The best of materials and appliances are used throughout, as it is inadvisable and almost impracticable in public buildings of this character, to exercise the many economies which prevail in private building.

The interiors are fitted with the best of modern appliances and conveniences; plumbing is extensive and perfect; the toilet rooms for Postoffice carriers are supplied not only with the usual appliances, but often with shower-baths; and no woodwork either in floors or in finish is allowed. Through the building, small private toilet rooms are provided for the more prominent officials; and in many, especially in the South, bathtubs are supplied. The heating, ventilating, and electric work are, in their lines, equally complete.

The buildings in the larger cities where the Railway Mail Service men change, have dormitories for the accommodation of from ten to seventy-five men. In the Postoffice proper are galleries with openings commanding every corner accessible to the men, from which Inspectors can watch for days, without arousing suspicion, any person suspected of pillaging the mails.

There is always a large "swing room" for carriers when off duty, where they provide themselves with games, boxing gloves, and occasionally a billiard table for recreation.

In the larger Postoffice buildings are the most perfect of mechanical equipments, engines, boilers, electric generators, elevators, mail-carrying and handling devices, sweeping machinery, etc.

From the above it is evident that there are few lines in the building industries which should not be interested in the erection and furnishing of these many buildings.

Building Conditions. It is a matter of interest to a very large body of contractors, sub-contractors, artisans of all callings, and material men and manufacturers, how the Department builds, and in what ways it differs from the average investor in its building operations and contracts.

There is a prevalent idea that mystery surrounds the getting the whole or any part of a government contract—that one must be on the inside and know how to pull the wires. This feeling arises probably from the facts that the Government as an Employer and Owner is a very different affair to deal with from a personal Owner; and, because of such difference, and because of the magnitude of the varied branches of work, rendering it necessary to have some fixed and unyielding rules and regulations to which all doing business with the Government must comply, the great mass of people who should be interested are apt to think that this is all "red tape" and that they cannot get near any of this work.

When the Owner and the Contractor in ordinary practice make an agreement, it is always modified by the personal conditions and qualities of each, so that the conditions and terms frequently differ materially in instances of work of the same character. With the Department, however, this cannot be. The Department has fixed policies and rules, and is hedged about by law in such a way that it must be unyielding at all points; it cannot adapt the work to the conditions of the Contractor; it can take no chances; and anyone seeking to do business with the Department must lay aside all personal ideas of methods, and must seek from the first to get into the line of the Department's methods and requirements, even if these appear to be without reason. The Contractor who imagines that he can take a contract, and can afterwards have its lines modified to suit his own methods, which he may honestly believe to be better than the requirements of the Department, is not only bound to be disappointed, but is certain to lose a round sum before final settlement.

When bids are asked for the construction of a building, the drawings and specifications are so prepared that the bidder is given notice relative to every requirement; nothing is taken for granted; it is fully set forth to what extent he is to be responsible for the completion of the work, and he is shown all details leading up to such completion. How and when each payment shall be made, is fully explained. Many of these requirements are unusual; he may not, and probably does not, understand why they are inserted; but that is really none of his business; the requirement is plainly stated; and if he wants to put in a bid, he has but to figure just what the cost of the apparently useless requirements will be, and to add such amount to his bid.

The conditions which govern Treasury contracts are the result of the experience of many years; and if a greater proportion of private Owners and Contractors for private work would adopt similarly exact methods in their operations, they would be attended with much fewer annoyances and much less friction. The Department is just as rigid in not permitting a Contractor to furnish something for nothing, as it is in not permitting him to substitute a poorer article than that required by the contract. Should the Contractor under any circumstances make a substitution, he is never safe. The Superintendent on the work may pass it; but the Contractor never knows when some traveling Inspector or other official may be put on the work and detect the change. In that case, the Superintendent, as well as the Contractor, receives severe censure, and the Contractor has either to rectify the trouble or to consent to a deduction of a good round sum, which usually represents several times the difference in value between the material furnished and that required.

It is fully set forth in the specification, that, in case of dispute regarding what is required or regarding the value of extra work, either as an addition or as a deduction, the decision of the Supervising Architect is to be final; and this means more than such clauses in private specifications, for the Department cannot be sued, and, in case the Contractor objects to the ruling and stops work, the Department has the power to abrogate the contract and finish the work at the expense of the sureties on the Contractor's bond. Later the Contractor can bring a suit in the Court of Claims; but it is very rarely that any substantial change is made in the original rulings. This rather autocratic power appears one-sided, and at first thought unfair; and, because of such appearance, it is never exercised except under extreme conditions, after every effort at reasonable settlement has failed; and then the decisions are such that, as above stated, the Court of Claims rarely reverses them to any extent.

This power is necessary for the Government; otherwise the Department would be at all times subject to inroads and impositions which would make progress impossible.

The sub-contractor and material man has no right of lien; but he has a right, after a certain lapse of time, to bring suit against the Contractor; moreover, the bond required by the Government, equal to one-half of the contract price, is also for his benefit, so that he has the same protection under the bond as has the Department. Upon application, certified copies of all contracts and bonds are furnished for his use by the Department, free. But the Department is under no obligation, nor has it any right, to withhold payments from the Contractor at the request or demand of unpaid creditors.

The relations of sub-contractors and material men to the Department are peculiar in that they cannot in any way be recognized in a business connection; they have no more connection with the Department than a factory which makes the shoe sold by a dealer has with the customer. The Contractor is the only business man known or recognized; all business of whatever nature must come under his signature. A sub-contractor can get no information or directions from the Department's representative. If it were otherwise, the Contractor would have just cause for complaints relative to interference with his business by the Government.

Many years ago a Departmental order forbade the requirement of any particular item so as to limit competition, or the mention of any particular material or appliance, "or its equal;" as a consequence, in the specification, there must be inserted such descriptions as will require appliances or materials which can be had through competition and which will accomplish the ends required. The Contractor is at liberty to obtain his samples for approval in any market he desires; but when such samples are approved, it is a very difficult matter to get a change made; were it otherwise, the Department would be constantly annoyed and delayed in its work by Contractors changing their minds relative to the parties with whom they wish to deal.

It is often urged by persons controlling some new and special appliance, that it is not good business for the Department to refuse to specify an article having all the good points which they can show to belong to the particular article controlled by them. If this idea governed, the office of the Supervising Architect would be overwhelmed by enthusiastic men with material and appliances of very doubtful value; and generally their claims would be urged by them and their representatives with a strenuousness in direct proportion to their worthlessness.

Experience has also shown that where competition relative to items entering into work has not existed, the persons controlling them rarely resist the temptation to charge abnormal prices. This results in the Contractor seeking relief at the Department and asking to be permitted to make a substitution; if this is granted, the higher bidders at once set up the claim that their figures were based on the specified requirements, and if they had known that such were not to be enforced their bid would have been low enough to capture the contract.

After a contract is once made, no one other than the Secretary of the Treasury, or, under certain circumstances, an Assistant Secretary, has the authority to make a change, no matter how small. The Superintendent on the work can allow no variations; nor has even the Supervising Architect himself any authority to make a change. For instance, two rough coats of plaster are required back of a certain wainscot; it is found advisable to omit the second; the area is small, and the difference in expense nothing; but the Superintendent must obtain from the Contractor a proposal to omit this coat without expense to the Government; and after this proposal has gone through the different divisions of the Supervising Architect's office for note, comment, and recommendation, the Assistant Secretary accepts the proposal in regular form as a public exigency, and with the understanding that it is not to affect the time for completion, or the obligation of the Sureties on the bond; etc., etc. If it were otherwise, the Superintendent would be constantly harrassed by requests and arguments for changes; and if he permitted changes, the worst of motives would be imputed to him.

So thorough is the system in the Department, that there is no detail too small for the fullest consideration. There is probably no Architect's office elsewhere in the world where all details receive such attention; and there are few transactions of any nature occurring within recent years, of which all details cannot be obtained by any official in the office in less than ten minutes.

When the red tape of the Department is considered from various standpoints, and the results reviewed, it should inspire more respect than is usually accorded to it; and the man who is seeking contracts or sub-contracts should first of all get into the spirit of the business methods of the Department, make his bid to cover all its requirements, and, if he gets the contract, use his best efforts to live up to the letter of every requirement. Such lines will bring success. Carelessness in following such will bring failure.

It is often stated that such and such persons have the "inside track" with Department work, and that there is no use bidding against them. This is in a sense true; but in all such cases it will be found that that "inside track" was laid by the Contractor getting in line with the Department's methods and doing business as thereby required; and the way is open for any other man to lay for himself such an *inside track.*

There is a prevalent impression that it requires some special effort to have an opportunity to figure on Department work. There could, however, be no greater mistake, as every effort is made by the Supervising Architect to obtain the best competition. For every building, from forty to sixty sets of drawings and specifications are printed and sent without charge (being carried both ways free) to any *general contractor* who makes an application. In a very few instances a certified cheque is required, the proceeds of which are returned upon the receipt of the drawing, etc., in the office. Sub-contractors and material men cannot be supplied, as it is impracticable to make a sufficient number of sets, and for the farther reason that it is desired that all sub-contractors and material men shall get all the information on which they base their bids from their principals, thus avoiding the danger of differences of opinion that might arise relative to the scope of the sub-bids.

When bids are desired, the work is advertised for from four to seven weeks, in representative technical journals throughout the country in the general section in which the work is to be done, and in the local papers of the town or city in which the building is to be erected. Notices as news items are sent to a very large line of trade papers, and also to Contractors within a few hundred miles of the city whose addresses are available; but such notices are discontinued if the party addressed does not submit a bid after notices of several buildings have been sent.

Many material men send in requests that their specialties be specified, and when they find that that cannot be done, drop all interest; whereas, if they followed up the matter, ascertained to whom the contract was awarded, and endeavored to arrange to sell any materials handled by them required under the contract, they would often obtain profitable contracts.

In order that the exact nature of the form which has to be signed by parties to whom contracts for Treasury buildings are awarded may be seen, a specimen contract is herewith reproduced, with occasional notes in smaller type to explain its provisions. The form of bond is also printed; but, as this varies little from that used in private contracts, no notes in explanation of the provisions of the bond will be found necessary.

CONTRACT

BETWEEN THE

UNITED STATES OF AMERICA

AND

JOHN DOE

WHEREAS, By advertisement, duly made and published according to law, proposals were asked for furnishing all of the labor and materials for the work herein provided for; and

WHEREAS, The proposal of JOHN DOE........................... furnished in response thereto, was duly accepted, as hereinafter stated, on condition that he execute a contract in accordance with the terms of said bid..

NOTE.—The *practical award* of the contract is a letter written by the Assistant Secretary of the Treasury (under written authority of the Secretary) to the successful bidder, accepting the bid and stating the principal conditions which are to govern—such as the price to be paid, time for completion—approving such appliances as have in the proposal sheet been offered for carrying out the contract (provided such are satisfactory), and settling the amount of bond to be furnished. This letter, referred to below, is attached to, and made a part of, the formal contract.

NOW, THEREFORE, THIS AGREEMENT, made and entered into by and between.........................., Secretary of the Treasury, for and in behalf of the United States of America, of the first part, and John Doe,
....
....
...., of the second part,

WITNESSETH: That the party of the second part, for the consideration hereinafter mentioned, covenants and agrees to and with the party of the first part to furnish all of the labor and materials and do and perform all the work required...
....
....
....
in strict and full accordance with the requirements of drawings numbered
....
....
....
and such other detail drawings as may be furnished to the party of the second part by the Supervising Architect of the United States Treasury Department; the advertisement for proposals, dated.................. 190 ; the specification for the work; the proposal dated................ 190 , addressed to the said Supervising Architect by the said party of the second part; and letter dated.............190, addressed to the said party of the second part by.................................. ....Assistant Secretary of the Treasury, accepting said proposal;..
....
....

(2)

Note.—The proposal often covers several pages. First the lump sum price is stated for the entire work; then follow many *Alternates*—that is, the amount the bidder will add or deduct provided certain materials are substituted for those required by the straight bid—as, for instance, the amount to be deducted for "Alternate A," substituting brick for all plain surfaces of the
Superstructure above 1st floor line .... $.......
After the alternates, *unit prices* are given. Thus:
Price per thousand for common brick in place................$.......
After this are lists of appliances to be used in the work. Thus:
Name of boiler proposed to be used...............................
Number of square feet of grate surfaces............................
Etc., etc.

a true and correct copy of each of which said papers is attached hereto and forms a part of this contract; and which said numbered drawings, bearing the signature of the said Supervising Architect and the signature of the said party of the second part, are on file in the Office of the Supervising Architect of the United States Treasury Department, and are hereby made part of this contract.

And the said party of the second part further covenants and agrees that the work herein agreed to be performed shall be commenced promptly upon receipt of notice of the approval of the bond hereto attached, and that the same shall be carried on in such order and at such times and seasons, and with such force as shall from time to time be directed or prescribed by the Supervising Architect or his representative, and that the same shall be completed in all its parts within....................
....
from the date of the approval of said bond hereto attached; that all materials used shall be of the very best quality of their respective kinds; that all the work performed shall be executed in the most skilful and workmanlike manner, and that both the materials used and the work performed shall be in every respect to the entire and complete satisfaction of the Supervising Architect.

And the said party of the second part expressly covenants and agrees that the bond hereto attached shall be security, also, for the satisfactory performance and fulfilment of all the guarantees set forth in or required by said specification.

....

....

Note.—No official has any right to permit a Contractor to do any work under the contract until the bond has been formally approved.

It is expressly convenanted and agreed by and between the parties hereto that time is and shall be considered as of the essence of the contract on the part of the party of the second part, and in the event that the said party of the second part shall fail in the due performance of the entire work to be performed under this contract, by and at the time herein mentioned or referred to, the said party of the second part shall pay unto the party of the first part, as and for liquidated damages, and not as a penalty, the sum of......................dollars for each and every day the said party of the second part shall be in default, which

(3)

said sum of..................dollars per day, in view of the difficulty of estimating such damages with exactness, is hereby expressly fixed, estimated, computed, determined, and agreed upon as the damages which will be suffered by the party of the first part by reason of such default, and it is understood and agreed by the parties to this contract that the liquidated damages hereinbefore mentioned are in lieu of the actual damages arising from such breach of this contract; which said sum the said party of the first part shall have the right to deduct from any moneys in its hands otherwise due, or to become due, to the said party of the second part, or to sue for and recover compensation or damages for the nonperformance of this contract at the time or times herein stipulated or provided for.

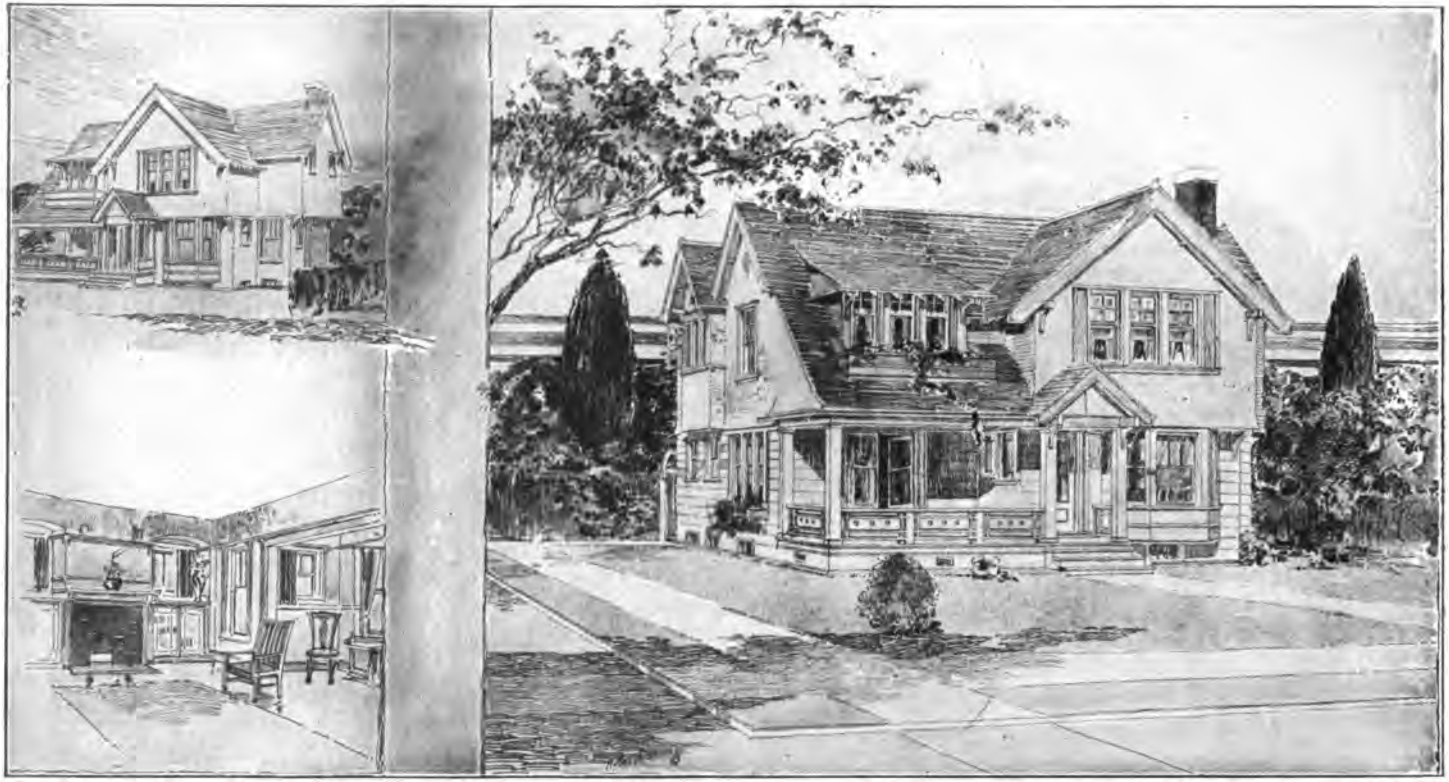
NOTE.—The question of *actual* damages is always a very difficult one to settle, and generally involves a lawsuit; therefore the contract states the amount of *liquidated* damages, or the amount settled and fixed in advance by both parties to be paid by the Contractor in case of default. While this amount is rarely less than $20.00 a day, with an average of about $40.00, the Secretary of the Treasury is empowered by Congress to remit so much as will reduce such sum to one that in his judgment is right; and as a matter of fact, it is usual to assess only such an amount as will cover the actual expense of maintaining a Superintendent on the ground, and any items of rent, etc., and additional inspections for which the Department has actually to pay on account of the failure to complete within contract time.

The party of the second part further covenants and agrees to hold and save the United States, its officers, agents, servants, and employees, harmless from and against all and every demand, or demands, of any nature or kind, for, or on account of, the use of any patented invention, article, or appliance, included in the materials hereby agreed to be furnished under this contract.

It is further covenanted and agreed by and between the parties hereto that the said party of the second part will, without expense to the United States, comply with all the municipal building ordinances and regulations, in so far as the same are binding upon the United States, and obtain all required licenses and permits, and be responsible for all damages to person or property which may occur in connection with the prosecution of the work; that all work called for by the drawings and specifications, though every item be not particularly shown on the first or mentioned in the second, shall be executed and performed as though such work were particularly shown and mentioned in each, respectively, unless otherwise specifically provided; that all materials and work furnished shall be subject to the approval of the said Supervising Architect; and that said party of the second part shall be responsible for the proper care and protection of all materials delivered and work performed by said party of the second part until the completion and final acceptance of same.

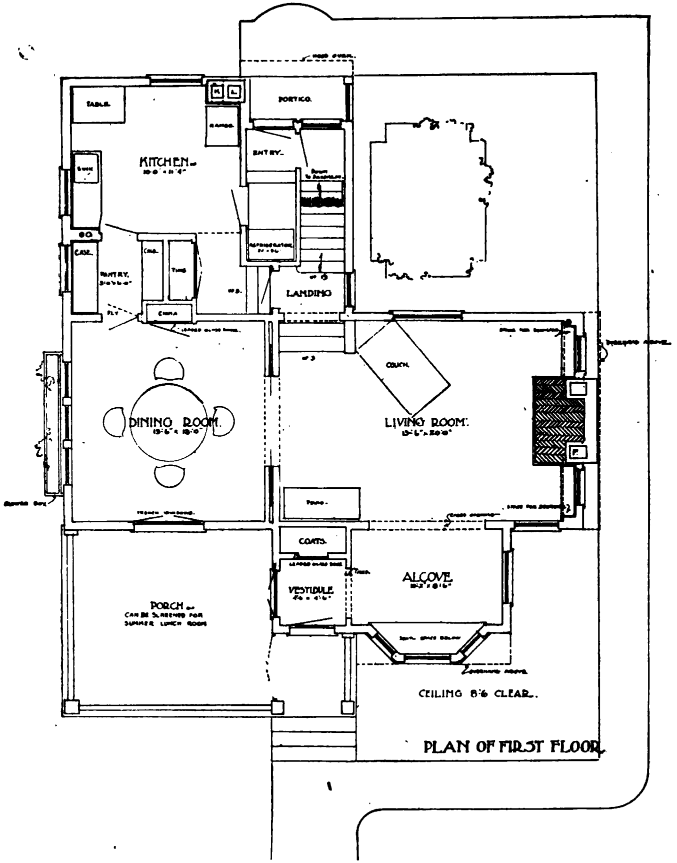
NOTE.—Municipal laws are binding on the Government to a very limited extent, and only outside of the lot line; the land, when bought by the Government, not only becomes its property, but it is, by such sale, *ceded* back to the United States, so that the land occupied by the public building is no longer a portion of the State, and the State or City has no more authority over it than it has over the District of Columbia.

Cases sometimes occur when some city official attempts to show authority, as in one case where a permit to enter the sewer was denied until some minor useless demand

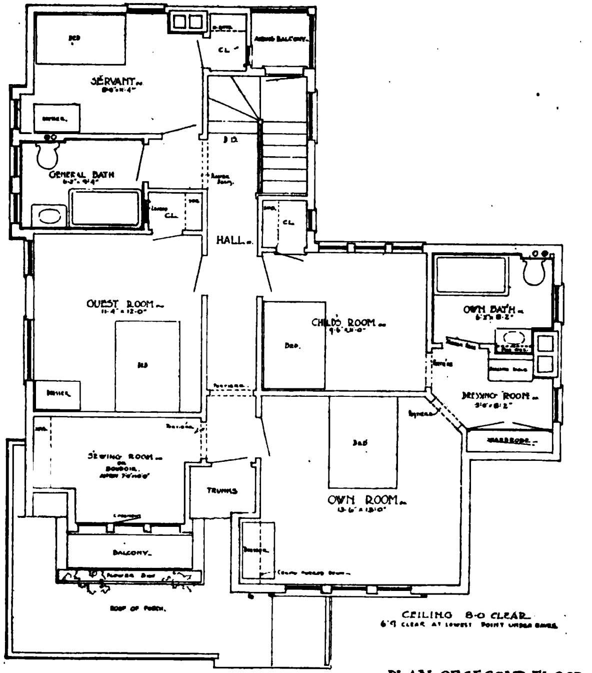


DESIGN FOR A $3,500 HOUSE.

N. Max Dunning, Architect, Chicago, Ill.



PLAN OF FIRST FLOOR.



PLAN OF SECOND FLOOR.

DESIGN FOR A $3,500 HOUSE.

N. Max Dunning, Architect, Chicago, Ill.

Exterior and Interior Views Shown on Opposite Page.

(4)

relative to the plumbing was complied with. The official had a perfect right to refuse the permit as the sewer was in the street; but after the Department had decided not to turn on the water, and to leave all plumbing fixtures unusable, the official soon found it better policy to allow the connection. This policy is always followed by the Government, as the practice of the Supervising Architect's office in all matters of this sort is the best, and is generally far better than that followed by many municipal laws.

Inside the lot lines, municipal and state authority do not exist, except for minor police regulations.

It is further covenanted and agreed by and between the parties hereto that the said party of the second part will make any omissions from, additions to, or changes in, the work or materials herein provided for whenever required by said party of the first part, the valuation of such work and materials to be determined on the basis of the contract unit of value of material and work referred to, or, in the absence of such unit of value, on prevailing market rates, which market rates, in case of dispute, are to be determined by the said Supervising Architect, whose decision with reference thereto shall be binding upon both parties; and that no claim for damages, on account of such changes or for anticipated profits, shall be made or allowed.

It is further covenanted and agreed that no claim for compensation for any extra materials or work is to be made or allowed, unless the same be specifically agreed upon in writing or directed in writing by the party of the first part; and that no addition to, omission from, or changes in the work or materials herein specifically provided for shall make void or affect the other provisions or covenants of this contract, but the difference in the cost thereby occasioned, as the case may be, shall be added to or deducted from the amount of the contract; and, in the absence of an express agreement or provision to the contrary, no addition to, or omission from, or changes in the work or materials herein specifically provided for shall be construed to extend the time fixed herein for the final completion of the work.

NOTE.—The somewhat arbitrary power referred to in the foregoing, is, as a matter of fact, rarely exercised; and when exercised, the greatest care is taken to make the amount such that it cannot be questioned. Sometimes Contractors imagine that, having the contract, they can demand for extras an exorbitant price, and they would be successful in many cases but for this saving clause.

It is further covenanted and agreed by and between the parties hereto that all materials furnished and work done under this contract shall be subject to the inspection of the Supervising Architect, the superintendent of the building, and of other inspectors appointed by the said party of the first part, with the right to reject any and all work or material not in accordance with this contract; and the decision of said Supervising Architect as to quality and quantity shall be final. And it is further covenanted and agreed by and between the parties hereto that said party of the second part will without expense to the United States, within a reasonable time to be specified by the Supervising Architect, remedy or remove any defective or unsatisfactory material or work; and that, in the event of the failure of the party of the second part immediately to proceed and faithfully continue so to do, said party

(7)

We hereby certify that this contract and bond have been correctly prepared and compared:

....

Chief of the Law and Records Division.

....

Superintendent of the Computing Division.

....

Secretary of the Treasury.

Witnesses to the signature of the Contractor:

Two witnesses.

....

....

....

Contractor.

Place corporate seal here.

NOTE.—**The above relates to one of the most vexing questions both to the Contractor and to the Department, which is encountered. When a Contractor gets hopelessly in default, it is as bad for him as for the Department to try to push through In such cases he is credited with the full value of all labor and materials on the ground; but for all additional items to complete the work covered by the contract, the sureties on his bond have to pay. Usually the bondsmen take the contract to finish the work; and in most cases, so far as the Department is concerned, no litigation follows.**

(1)

BOND

KNOW ALL MEN BY THESE PRESENTS, That we,...................... .... of the City of...................., County of................, and State of..............., principal , and.......................... .... of the City of.................., County of.................., and State of......................., and.......................... of the City of.................., County of.................., and State of............, suret......, are held and firmly bound unto the United States of America in the sum of...................dollars ($..........), lawful money of the United States, for the payment of which, well and truly to be made to the United States, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.............................

Sealed with our seals and dated this......day of ...., A.D. 190 .

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, That whereas the said...........................ha.. entered into a certain contract, hereto attached, with.............................Secretary of the Treasury, acting for and in behalf of the United States, bearing date the ....day of............................, A.D. 190 : *Now*, if the said.. .... shall well and truly fulfil all the covenants and conditions of said contract,

(2)

and shall perform all the undertakings therein stipulated by.......... to be performed, and shall well and truly comply with and fulfil the conditions of, and perform all of the work and furnish all the labor and materials required by, any and all changes in, or additions to, or omissions from, said contract which may hereafter be made, and shall perform all the undertakings stipulated by......to be performed in any and all such changes in, or additions thereto, notice thereof to the said suret........ being hereby waived, and shall promptly make payment to all persons supplying..........labor or materials in the prosecution of the work contemplated by said contract, then this obligation to be void; otherwise, to remain in full force and virtue..........................

In testimony whereof, The said..............................
....
........................., principal , and....................
....
and.., suret.......
have hereunto subscribed their hands and affixed their seals the day first above written..

Signed, sealed, and delivered in presence of...............

Two witnesses to each signature.

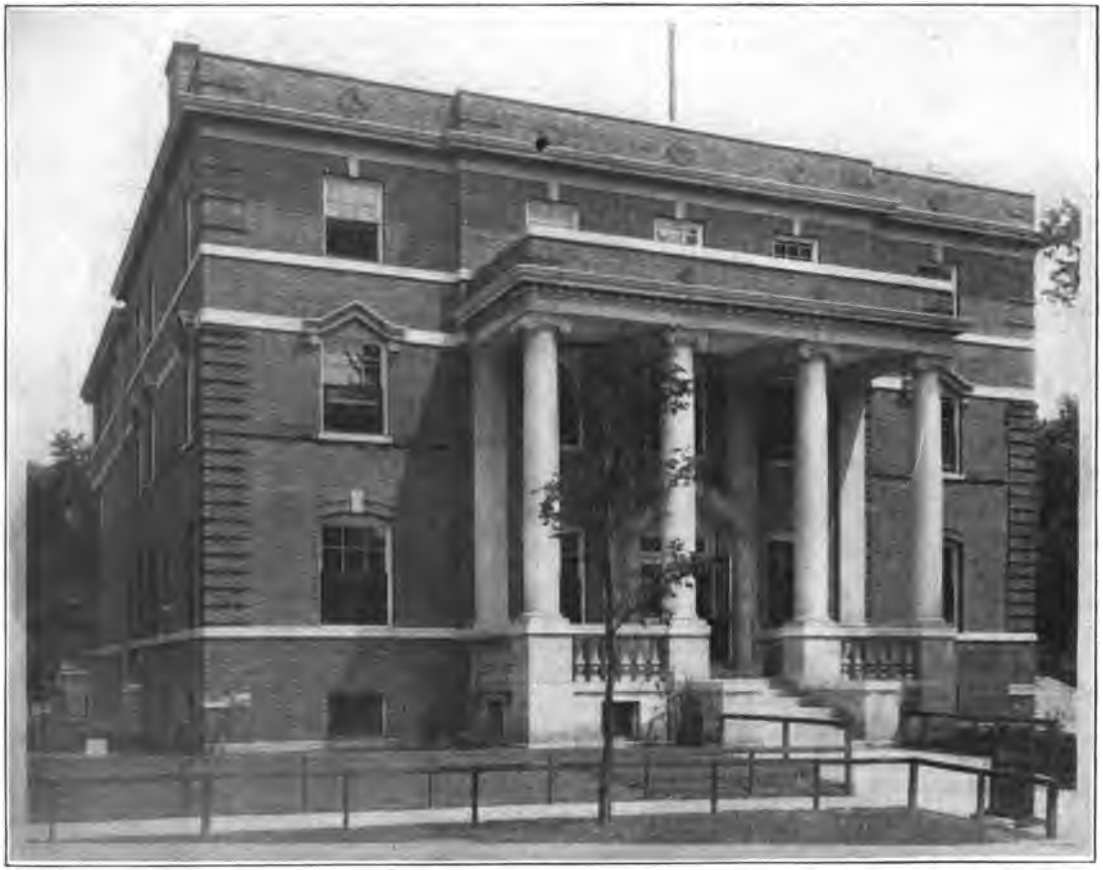
....
....
....
....
....

[SEALS OF WAX OR WAFER.]

Note.—It will be observed that on each page, both of form of contract and of bond, each type line is numbered, 1, 2, 3, etc. This is customary in all such government documents, and is for the purpose of locating references, interlineations, etc.

At first glance, this contract appears to be one-sided in that it confers on one side certain seemingly arbitrary power which, if used in the extreme, would be disastrous to any Contractor; but, as a matter of fact, the Department uses its extreme rights with the utmost caution, and generally goes more than "half-way" in disputed settlements.

Where disaster occurs—such, for instance, as in a cyclonic wind, wrecking work in place, as happened at the Pan-American Exposition; or in damage by fire, as in the Baltimore conflagration--the Department promptly recommends that Congress make a reimbursing appropriation to be used in replacing work damaged; and that body always responds, recognizing a moral if not a legal obligation.



YOUNG MEN'S CHRISTIAN ASSOCIATION BUILDING, OAK PARK, ILL.

Pond & Pond, Architects, Chicago, Ill.

Walls of Cherry Red Paving Brick, Trimmed with Purple Red Paving Brick. Columns, String-Courses etc., of Bedford Stone. Built in 1905.

CONTRACTS AND SPECIFICATIONS

PART II

Prefatory Note.—Part I was intended to initiate the student in the fundamental principles of specification writing, by setting forth the nature of the preparation desirable and necessary for successful work. The entire field was by no means covered, nor was it the intention to state the only lines which could be followed.

Part II has been compiled from *various sources* with the intention of showing different phases of the work, and aiding those students who have carefully worked out the more fundamental lines.

Because some things are stated differently in one part from the other, is no reason for considering either line wrong. No one set of rules or directions will apply to all cases; and therefore the differences between the two parts, it is believed, will lead the student to compare in each case the two lines, and choose the one best adapted to the case he may have in mind, or else to go on and work out some third or independent line which will better than either fit the case. The man who thinks and reasons, provided he is well grounded in fundamentals, will rarely make a mistake.

A *Specification* is a statement of the conditions under which a building is to be constructed, and of the items necessary therefor which are not indicated on the contract drawings.

A *Contract* is a detailed statement of the agreement between the Owner and the Builder, for the execution of the project as required by the drawings and by the specification.

GENERAL SCOPE OF THE SPECIFICATION

The specification presents the general conditions under which the work indicated by the drawings is to be executed. It calls for the kind and quality of labor and materials desired, and contains all the written instructions and descriptions that may be needed to indicate fully to the bidders just what is required to be furnished.

Specifications must be written in language perfectly intelligible to all persons connected with the work; and special care should be exercised, as they, together with the contract drawings, form the basis of the final agreement or bargain between the Owner of the proposed building and the Builder, which agreement is called the "contract."

The building to be erected is described by the Architect in two ways—namely, by *drawings* and by a *written description* (the specification). The same experience and ability that enable him to make the drawings, will be required in giving the verbal statements necessary to express what cannot be fully shown in the design. The purpose of the specification is to state the *character* of the work and material, as distinguished from the *sizes* and *quantities* shown in the drawings. The importance of the specification is shown in the fact that it takes precedence over the drawings in case of discrepancy.

The term "specification" is used sometimes, though not commonly among builders, as a legal expression to mean the plans, specification, and contract, which are the essential documents in connection with the erection of a building.

It is advisable to block out a *memorandum specification* indicating very generally the points which will be completely covered in the finished copy, and to do this at the time the sketches are made, which indicate in a general way the scheme to be followed later in the contract drawings. On them a close estimate of cost can be made, and the necessary modifications incorporated to bring the cost of the work to the required sum. In the final writing, however, this memorandum should be used only for reference, as an effort to copy any part bodily into the completed work is apt to introduce matter not desired, or to cause the omission of essential matter not considered at the time the memorandum was made.

As a general rule the specification should give the quality and kind of material used, and the method of workmanship, leaving the quantities and sizes to be obtained from the plans. If this method is carefully followed, it makes the checking up more simple in completing the plans. Changes in quantities and dimensions can be made on the plans, while changes in material are looked for in the specification.

If the method of writing the specifications very completely, with a few small-scale drawings, is followed, much more will have to be written, especially in regard to the sizes and quantities of mouldings, dimensions of expensive material, etc. Drawings at a scale of ⅛ inch to a foot will require more explanation than ¼-inch scale plans, unless ½-inch or ¾-inch scale details accompany the small-scale drawings. Such information, for example, as the size of wooden mouldings, or the number of inches required in section for a copper gutter, can be stated in the specification.

The completeness and clearness of the specification generally govern the amounts of the bids, and also regulate the amount of extra charges brought in by the Contractor at the final settlement.

Reference should be made to everything required for the building, unless it is of such a nature that the drawings leave nothing to describe or require; but any description of work which is fully set forth on the drawings, is out of place.

The specification should be correct and complete, and should be written by a person who fully understands, and who is in thorough sympathy with, the design.

The specification, while setting forth most clearly the points under consideration, should not be longer than is absolutely necessary to convey the intended ideas; there should be no repetitions of requirements.

The materials to be specified for general use, should be stated first in this way: "All——not otherwise specified, to be——." This not only saves much repetition, but also gives a definite, stated material for minor places that otherwise would require long and tedious listing.

Accurate specifications save money to the Owner; but if too verbose, they may scare the bidder, and cause unnecessarily high estimates.

A simple description, giving as briefly as possible the correct idea to the builder, is likely to achieve a better result than a long treatise on what is recognized as good workmanship and material by any workman capable of undertaking the contract at all.

Words should be used in their most common sense, and if an expression indicates only a trade term for a certain locality, it should be so stated. "First quality," as a trade term, for example, may not mean the best in the market; "Extra No. 1" shingles are not so good as "Extra;" "6-cut" stone work may show many "stuns" which would not appear if "Good 6-cut" were called for. If the Architect is not fully informed on these points, he should study more carefully the grades of materials being put into buildings, and how they appear on buildings where they have stood for some time. Visits to supply-houses, mills, shops, and stone yards, will repay the time spent.

Such expressions as "best," "proper," "sufficient," etc., are capable of being interpreted in very different ways according to the point of view of a good or a poor workman.

It is often necessary, in order to save superfluous lettering on the drawings, and also because of lack of space, to use abbreviations in indicating material, etc. As these abbreviations differ in various localities, it is always necessary to insert in the specification a "legend" or list of abbreviations used and their meaning.

Each requirement should be so carefully written that there can be only one interpretation, leaving no doubt as to its true intent. If the specifier hopes to get better work through some hidden meaning in the specification, he is doomed to disappointment; for the more expensive interpretation will be used by the Contractor in making up his bid; and later, when the work is required, the Contractor may plead that, on account of the uncertainty of meaning, he should not be required to furnish any part without extra compensation. Make the specification fair and honest, for it is the basis on which the Architect will stand as arbitrator during the progress of the work.

It should be remembered that it is the province of the workmen to comprehend and not to originate; and so the statement of what is to be constructed should be made very clear, leaving nothing to the imagination of the Contractor; a statement in the specification of what could be better shown on the drawings, is apt to be poorly comprehended by the builders. On the other hand, the Owner of the building is apt to think more of the specification, as he can understand this more clearly than he can the drawings. There should be nothing, however, in the specification, or in any part of the work, to discourage originality, personal interest, and the exercise of judgment on the part of the workmen, where these will not act contrary to the general scheme or the rapid progress of the work.

It should be stated and understood that every Contractor is to report any defect or discrepancy as soon as observed, to the Architect, and to lend his personal interest and attention to the best possible execution of the whole work.

The sets of specifications, as well as the drawings which they accompany, both on receiving estimates and when signed with the contract, must be kept unchanged, for reference. Later changes must be shown by other drawings and by *Addenda* to the original specifications.

Interlineations in a specification should not be made if there is time for rewriting. If made at the last moment, they should be signed individually at the time of signing the contract.

All changes after the specification is completed and the contract let, involving extra charges, should each have a complete descriptive specification written, referring to the general specification. This can be done in the form of a triplicate letter, of which one copy is sent to the Contractor, one copy to the Owner, and the third remains as the office memorandum, or is attached to the office copy of the specification.

The specification is sometimes written on the drawings; but these easily become separated, so that the specification might not be considered for every part of the work on which it would have a bearing; moreover there is usually not sufficient room on the drawings for going sufficiently into detail.

Notes on drawings in the form of a specification, have these disadvantages:—They depart from the principle of employing:

Specifications For Verbal **Drawings For Graphic**	presentation of requirements;

they lead the Contractor to neglect to look at the specifications; they never can be complete verbal descriptions.

The advantages which lead many Architects to specify by notes on drawings, are:—They are directly before the Contractor; they can be easily and permanently put on when making drawings; they show the exact location of materials mentioned.

Specifications are usually typewritten, several copies being made, one copy for the owner; one to three for the Contractor; one office copy; and extra copies which may be used in securing estimates, for the inspection of Building Department, etc. The specifications are sometimes lithographed, printed, or mimeographed, where many copies are required. It is the custom, in some offices, to print in typewritten form, or to mimeograph the general conditions only, which remain the same in different specifications. Unless the general conditions are written in the same form as the general specifications, the Contractors are likely to overlook them and to neglect the directions stated therein.

Sometimes sketches are made in the margin of the specification, to indicate the use of materials or to show details that are required. This can be done easily if the specifications are printed or lithographed; but under the present system of duplicating by typewriting, it is difficult to do this. This sort of information can be shown more completely on the regular drawings, which can be reproduced in sufficient quantities to explain every item.

The writer of the specification must clearly bear in mind throughout his entire work, that the Architect is to occupy a unique position in carrying out the work—a position which, in almost no other line, is occupied by one individual. The Architect is the confidential professional adviser of his patron; and also, as the work progresses, he is to be the unbiased arbitrator, often between opposing interests, one of which is that of his patron or employer. The latter is a position not only difficult but generally impossible to occupy at all times to the satisfaction of both parties; and as the unconscious influence of the patron's interests is very apt to warp the judgment of the Architect in making interpretations which must govern, it is very necessary that in writing the specification the matter be stated so clearly that differences of interpretation will occur seldom, and that when they do occur the specification will give the Architect ample standing room so that his judgment may be accepted without either party feeling wronged.

There are certain data that it is advisable to obtain before writing the specification—such as the data obtained from test borings to determine the condition of the soil, also the location of sewers and water-supply pipes, etc.

Preliminary estimates are generally obtained from one "reliable Contractor," who can be called in before the specification is complete, to estimate the relative cost of certain parts of the building, where there is some doubt as to which of two methods or materials to use.

It is better, however, for the Architect to become familiar with the cost of different items, so that he can estimate for himself the cost of various schemes, unless the Owner has settled on one particular Contractor to whom the work is to be let. When the "reliable Contractor" is called in, he appreciates fully that the time he puts on the estimate will be in the nature of gratuitous services or nearly so, and therefore careful figures are not made, and often the Architect and Owner are both misled.

The opening description of the work should be straight-forward, clear, and concise, and the specification carefully classified according to the different trades, so that each sub-contractor and the estimator of every small shop may find the work he is to do definitely indicated. It is easy for a general Contractor to unite sub-contracts and let several to one firm, but very difficult to subdivide a specification where trades are not separated.

This should not lead the Architect, however, to separate work among different trades where for safety, warranty, or promptness, certain parts of the work should all be under the control of one contractor, *e.g.*, the roofer.

Each item describes the class of material to be used and the kind of labor to be employed. The number of pieces and the dimensions are left to the plans; though, when the plans are incomplete on account of the small scale, the quantities and sizes must be specified fully and completely.

The usual method of arranging a specification is to classify the items under each building trade, and then subdivide the building trades as much as possible. Commence with the work to be done on the foundation of the building, and carry the description up through the building to the roof chronologically in the order of construction. In this way there is less danger of omissions. Sometimes it is advisable to describe a certain part entirely under the trade that would have general charge of it. For example, an iron staircase would be described under "Iron work," and the description would include a wooden hand-rail. Metal flashings are often specified to be furnished by the carpenter, mason, or plumber for use in connection with their work, though frequently these are provided by the metal worker and set by the carpenter, mason, or plumber.

An expeditious method of writing specifications, which may be employed to advantage in large offices when the writer is not intimately associated in the work of preparing the drawings, is to write each item on a catalogue card. The best sizes for this are either 4 by 6 inches or 5 by 8 inches. The latter is preferable, being the width of ordinary typewritten specifications, and large enough for notes and memoranda regarding each particular item.

Guide cards may be used to separate these items under their different headings, and the items can be easily rearranged or added to at any point. When a new specification is written, all that is necessary to do is to put markers or wire clips on the cards that are to be used, making any changes that may be necessary in pencil on the card and writing or dictating any additional items for insertion. The whole specification can then be typewritten from these cards on which the "signals" have been placed, making as many copies as required. Whenever cards are removed from the case, large "out" markers are put in their places, so that they will be returned to their proper locations.

When the specifications are ready to be typewritten, they should be carefully checked up with the drawings and with the "Specification Reminder," which will be explained later.

In writing out the specification, it is advisable and usual on public work to number every clause under the different trades in order. These will be found very useful for reference and correspondence during the work. An index may be placed at the beginning of the specification.

There are many indirect items which should be fully covered by the specifications—for example, that the Contractor shall take care of certain minor points, such as clearing out rubbish, covering the windows, and heating the building while the plaster is drying, putting up staging, etc. Even when there is a general Contractor for a building—which would relieve both Architect and Owner of any direct responsibility—it saves much discussion between the sub-contractors if such points as these are included in the specification.

Where there are definitely stated requirements in State or Municipal building laws, use the same wording or expressions in the specification. These are the result of long study and practical experience, and often the difference of a single word will confuse or make the meaning much less clear to Contractors. The specifications may be abbreviated by referring directly to the building laws, and omitting what is there clearly stated.

Electric wiring, for example, should be done according to the "Rules and Requirements of the National Board of Fire Underwriters for the Installation of Electric Wiring, as Recommended by the Underwriters' National Electrical Association."

While every specification should require that the work as a whole and in all details shall be carried out to the satisfaction of the Architect, such requirement must carry with it the full understanding that the Architect shall be satisfied when the Contractor has furnished what the clear meaning of the drawings and specifications calls for, and under no circumstances shall the Architect demand other than what is required by the drawings and specifications, under the excuse that what has been furnished is not satisfactory to him.

It is often desirable to stipulate that certain portions of the work, etc., are warranted to exercise their functions properly when completed, and for a certain period of time thereafter. For example, the heating specification may stipulate that the apparatus is to maintain a temperature of 70 degrees when that of the outside is at zero or 30 degrees below. Or it may be that the roofer is to warrant the roof to remain waterproof for a certain length of time. Such warranty clauses should be sparingly used, as, in case of defect in the portion warranted, it is generally as expensive to get the person who installed the defective portion to remedy it, as to get the work done over by another party, and the delays incident are annoying in the extreme. When such warranty clause is used, it is generally made an excuse for constantly changing the work from that specified, under the plea that, if carried out in accord with the contract, the work cannot be warranted. Such changes are always in favor of poorer work. It is generally better for the Architect to know just what will do the work, see that such is installed, and leave the warrant clause out.

Specifying a particular make or brand of material is apt to carry the impression that the writer's knowledge is limited or that he is unduly influenced in favor of the article specified. If a particular appliance is required, it is well to except it from the contract, and say that the Owner will furnish a ———— delivered on the site, which the Contractor is to set in place and connect, etc.

In large and important work it is sometimes customary for the Contractor to submit the names of the sub-contractors whom he proposes to deal with, for the approval or disapproval of the

Architect. This requirement is inserted in order to prevent workmen of indifferent character getting onto the work. It is a very delicate problem for the Architect to pass judgment on sub-contractors; and if, after approval, they furnish unsatisfactory material, it is embarrassing to reject it if it puts the general Contractor to loss. This clause, therefore, as well as the warranty clause, should be used only after very mature consideration, and never in the less important work.

In important work, specifications on electric wiring, heating, plumbing, ventilation, etc., are frequently prepared by consulting engineers employed by the Owner to arrange these points under the direction of the Architect. In this case the engineers prepare the specifications, which can be included in the Architect's other specifications; and any changes that may come up during the progress of the work should be referred to the consulting engineer by the Architect, before change is made. This is quite customary in the erection of high buildings, where engineers are frequently employed to lay out the steel construction.

But when the services of specialists in any line are required, it should in all cases be understood that the general scheme for the work should not be altered, that the Engineer should adapt his portion of the work so as to carry out the general plan, and should not insist on modifying this to suit any particular methods or appliances he may desire to use.

In a building operation, four questions always arise:

(1) What is to be done?
(2) How is it to be done?
(3) When is it to be completed?
(4) What is to be the manner of payment?

The first two questions are answered by the plans and specifications.

Although the last two are finally stated in the contract, it is necessary that some reference should be made to them in the specification, for information to bidders.

The periods for completion may be stated in terms of months and days after the signing of the contract.

Payments on the contract may be by:

Stated sum,
Cost plus a percentage,
Cost plus a percentage with guaranteed limit,
Cost plus a fixed sum.

The first is the usual method of contracting.

Full information relative to the method of payment which the Owner prefers and intends to incorporate in the contract, should be fully set forth in the specification, as this is a matter which will have a marked influence on bidders.

While the first method is the usual one of awarding a contract, unless the payments can be arranged so that the owner pays for the material and labor at frequent intervals, it follows that the Contractor has to use considerable of his own capital or credit to carry the work along. For this he must be paid; and therefore, as the Owner generally has the funds prior to beginning work, it is advisable to state in the specification such dates and percentage of payments as will permit the Contractor to carry on the work with a minimum charge for the use of his own capital or credit.

The completeness and clearness—and therefore the usefulness—of a specification, depends on its systematic arrangement. The first thing to do, therefore, is to prepare a skeleton or outline of what is later to be the finished form. This should consist, in the first place, of a list of the different *general* branches of the work, such as:

MASONRY.
STEEL AND IRON.
ROOFING AND SHEET METAL.
Etc., Etc.

Then, under each of these general heads should be set a list of subheads, in general, as follows; but it is not good policy to attempt to cover every point before beginning the writing of the specification proper, as, in writing, items will constantly occur to the writer in connection with what has already been written.

MASONRY—
  Alterations and Shoring.
  Demolition and Removal.
  Stone Masonry.
  Brick—Terra Cotta.
  Etc., Etc.

STEEL AND IRON—
  Structural.
  Ornamental.
  Etc., Etc.

After this skeleton has been prepared, the major part of the work is done, as the filling-in and detailing of requirements under each heading is a comparatively simple operation.

In smaller work, when the Architect is the designer and specification writer, the matter will be or should be so in mind that no assistance should be required in arranging this skeleton; but in larger offices, where generally the first time the writer sees the drawings is when he begins consideration of the specifications, it is very desirable—in fact, necessary—for him to have some reminder of the items which are to be considered. These reminders were referred to on page 73 in connection with the card index of subjects; and as practice extends, these specification cards, with their accumulated notes, become very valuable. It is desirable, as items are observed in technical papers and about buildings in course of construction, and from conversation, to make careful and much abbreviated notes from day to day on the cards under the proper heading, which will recall the details of the case when this will be of assistance later.

There is given on page 79 a list of headings which cover certain items generally needed, with occasional notes written out to illustrate how other notes can be made when experience furnishes the matter. It is especially desirable to call attention in the notes to any difficulties in any line of work which have been particularly noted from any source.

In order to make the best use of these reminders in preparing a specification, the drawings, after they have been delivered to the specification writer, should be most carefully studied so that the whole scheme of design, arrangement, use, construction, and decoration may be well in mind. Having obtained a general comprehensive impression, the general method of obtaining the results desired is next to be studied. A considerable time can be spent in this work to advantage. It is a good plan after what is considered to be a sufficient period of study, to sit down, close the eyes, and call up in mind the different parts as a whole and in detail. If the scheme then appears clear, and can be followed out understandingly in mind, without reference to the drawings, then—*and not until then*—is the writer fitted to begin the work. He can then with surprising rapidity lay out his first line of main heads, and with a similar rapidity his subheads, which completed the main part of the work is done. Stress is here again laid on the importance of the clear mental comprehension of the entire scheme, as a whole and in detail, before a word is written. If the writer fails in this grasp, his specification will be neither clear nor complete, and is very apt to degenerate into a series of disconnected sentences with little or no affinity to those which precede or follow.

After the grasping of the situation as above outlined, look through the lists of *general headings*, noting each head that applies to the work in question; then look under each Subdivision of the general headings, in a similar way noting each item that applies to the scheme under consideration.

SPECIFICATION REMINDER

GENERAL CONDITIONS—

Division of Work.
Work to be Done.
Quality.
Materials and Labor.
Delivery of Materials.
The Contractor.
Laying Out the Work.
Engineer.
Permits.
Building Laws.
Fences.
Office.
Vouchers.
Inspection.
Protect Work.
Rubbish.
Scaffolding.
Defects.
Assist Other Contractors.
Cutting.
The Architect.
Drawings and Specification.
Detail Drawings.
Charges.
Bond.
Insurance.
Ownership of Old Material.
Water Supply.
Temporary Water-Closet.
Contingent Work.
Award.
Terms of Payment.
Changes.
Time for Completion.

MASONRY—

ALTERATIONS AND SHORING—

Shoring.
Raising.
New Openings.
Piers.
New Underpinning.

Demolition and Removal—

Old Building.
Tearing Down.
Removing Walls.
Brick.
Old Vaults and Cisterns.
House Mover.
Ownership of Old Material.
Removal of Old Material.

Excavation and Grading—

Location.

(If there is much change of level it is advisable to have a surveyor lay out the finished grades.)

Clearing the Site.
Excavate for Cellar.
Excavate for Areas.
Excavate for Drains.
Excavate for Water.
Excavate for Cesspools.
Blasting.
Grading.

(If possible, have the scheme of grading laid out before beginning to build, in order that the earth excavated from the cellar may, with one handling, be carried to the proper location to carry out the scheme.)

Footings below Frost.
Shoring.
Bracing.
Temporary Piling.
Surplus Earth.
Save Loam.
Trees.
Shrubs.

Stone Masonry—

Lime—Cement—Sand.
Non-staining Cement.
Mortar—Ties.
Facing Walls.
Bed of Stone.
Bond of Stone.
Damp-Proofing.
Coping.
Curbing.
Concrete Floors.
Steps.
Walks.

Cut Stone—

Stock—Limestone—Sandstone —Granite.
Finish.
Carving.
Cleaning.

Concrete Construction—

Cement—Sand—Aggregate.
Mixing.
Reinforcing Materials.
Blocks—Beams—Forms.

Brick Laying—

Common Brick—Sand Mould— Pressed—Enameled.
Lime—Cement—Sand.
Bond; Common, English, Flemish.
Cutting.
Wetting Brick.
Freezing Weather.
Bedding Window-frames.
Chimneys, Flue-linings.
Chimney Caps.
Chimney Bars.
Chases.
Hollow Walls.
Boiler Setting.
Register Openings.
Rough Fireplace Openings.
Iron Doors.

TERRA COTTA—

Partitions.
Floors.
Furring.
Fireproofing.
Ornamental Terra-Cotta.

PLASTERING—

Grounds.
Wood Lath.
Metal Lath.
Back Plaster.
Two-coat Work.
Three-coat Work.
Exterior Plaster.
Pebble dash.
Lime and Sand Mortar.
Hair.
Patent Plaster.
Corner Beads.
Cornices.
Relief Work.

TILE WORK—MARBLE AND SLATE—

Fireplaces.
Interior Marble Work.
Mosaic.
Terrazzo.
Bathroom.
Walls—Floors.
Plumbing Marble.

STRUCTURAL STEEL AND IRON—

Quality
  Cast.
  Wrought.
Tests.
Bolts.
Rivets.

ORNAMENTAL IRON AND BRONZE—

Cast.
Forged
Grilles
Elevator Enclosures.
Steps.
Coal-Hole Cover.
Stable Fittings.

MISCELLANEOUS IRON—

Fire-Escape.
Balconies.
Wire Guards.
Tree Guards.
Wheel Guards.

SHEET-METAL WORK—

Copper.
Lead.
Zinc.
Gutters.
Ventilators.
Flashings.
Skylights.
Cornice Work.
Eave Troughs.
Speaking Tubes.
Ventilation Flues.
Heat Ducts.

ROOF—

Tar and Gravel
Copper.
Canvas.
Tin.
Shingles.
Slate.
Valley.
Flashings.
Snow Guards.

CARPENTER WORK—

Framing.
Sheathing.
Lining.
Flooring.
Finish Lumber.
Paper.
Doors.
Sash.
Blinds.
Glass.
Window Weights and Cord.

Exterior Finish.
Cornice.
Interior Finish Pine.
" " Hardwood.
" " Natural.
" " for Paint.
Closets.
Refrigerators.
Mantels.
Stairs.

HARDWARE—

Locks.
Knobs.
Escutcheons.
Sash Locks.
Sash Lifts.
Springs.
Hooks.

Knocker.
Hinges.
Special Hardware for Casement Windows.
House Number.
Blind Fixtures.
Screen.

PAINTING—

Quality of Lead.
" " Oil.
" " Shellac.
" " Varnish.
Colors.
Putty.
Whitewash.

Number of Coats for Each Material.
Finish.
Exterior Stains.
Metal Work.
Roof.
Interior Walls.
Plumbing Pipes.

GLASS—

Plate—Double-Thick; Single-Thick.

Stained—Ribbed; Wire.
Glazing; Cleaning.

HEATING—

Laying out Work.
Cutting, etc.
Foundation.
Flue.
Furnace.
Cold- and Hot-Air Ducts.
Registers.

Boiler.
Piping and Hangers.
Valves.
Heat Regulator.
Radiators.
Tank.
Boiler and Pipe Covering.

PLUMBING—

- Fixtures.
- Bowls.
- Closets.
- Bathtubs.
- Wash-Trays.
- Sinks.
- Urinals.
- Connection with Waste Pipes.
- Laundry Stove.
- Hot-Water Boiler.
- Water Front.
- Water Piping.
- Shut-off Cocks.
- Soil Piping.
- Branches.
- Traps.
- Refrigerator Waste.
- Back-Air Pipes.
- Fresh-Air Inlet.

GAS—

- Pipes.
- Tests.
- Outlets.
- Stove Connection.
- Gas Machine.
- Gas Logs.

ELECTRIC WORK—

- General Description of Scheme.
- Wire.
- Conduits.
- Outlets.
- Fixtures.
- Switchboard.
- Switches.
- Meter Connections.

The above lists as given are not intended to be in any sense so complete as to be a sufficient guide to work in *all* buildings. They are inserted to illustrate the scheme often used in offices where the specification writer is somewhat unfamiliar with the work already laid out on the drawings. Practice differs so radically, and the range of building is so wide, that a comprehensive list covering all the multiplicity of questions that arise in connection with buildings, would be cumbersome. But, following the lines above laid out, each specification writer can rapidly accumulate what he needs in his particular line; and the *operation of seeking* for new items of importance in practice will be a source from which much valuable information and experience will be obtained.

Before proceeding further, the reader should prepare a schedule following the above lines, but should specify under each heading at least double the number of sub-items mentioned.

He should also write a description of the character of work referred to by each heading, these descriptions each to contain approximately one hundred words. For instance, under the head of "Heating," a statement along lines similar to those given below would fill the requirements.

HEATING

There are five principal methods of heating dwellings—namely, by Fireplaces, by Stoves, by Furnace, by Steam boiler, and by Hot-water boiler, all adapted to fuels in common use.

Fireplaces are suitable for mild climates, and to supplement more efficient apparatus in cold climates.

Stoves are the most economical, but are often objectionable fixtures.

Furnaces deliver heated air to the various rooms; and, for small buildings, are satisfactory.

Steam and hot water generally supply heat from radiators in each room. Steam is quicker to respond than hot water; it therefore should be used when quick changes in temperature are desired, and in the larger class of buildings, where it is more easily controlled.

Hot water should be used when an even temperature at all times is desired.

The accompanying specification is given to show the method of writing a specification for a certain building. In every case the Architect should consider every item that is wanted on the building, and should write out exactly what is desired.

New problems are constantly arising which tax the ingenuity of even the experienced Architect, and which require new directions. Many building operations will have requirements so unusual that any aid except that of general experience will be of little value. As a rule, however, careful and constant reference to, and comparison with, the plans, adding to or changing similar previously written or printed specifications as used on past work, or separated item by item on cards, will give a good result. This should be carefully checked with the "specification reminder," to discover omissions, before sending out the drawings. In work containing unusual or elaborate detail in intricate alterations, it will be easier to write out the specification completely than to alter an existing one.

At first, with the plans closely in mind, and generally hung on a wall or screen near by, the specification writer should block out the list of headings, forming a skeleton or general synopsis of the whole specification. Then he should go through the different trades, checking, writing, and dictating, either following a card catalogue, taking a printed form or standard specification and filling in the blanks, or using an old specification and interlining the changes, which are then copied to form the complete document. Extra care must be taken to cover new and important points that are likely to be insufficiently studied. It will be found quite difficult to make an old form apply to a new building, without the use of too many general terms and "blanket clauses."

Having made a thorough study of the subject, the following list of headings may be understood to cover the work in question.

I. GENERAL CONDITIONS.
II. EXCAVATING AND GRADING.
III. STONE WORK.
IV. BRICK WORK.
V. LATHING AND PLASTERING.
VI. METAL WORK.
VII. CARPENTRY—
    Framing.
    Exterior Finish.
    Interior Finish.
    Hardware.
VIII. GLAZING.
IX. PAINTING.
X. HEATING.
XI. PLUMBING.
XII. GAS-FITTING.
XIII. ELECTRIC WIRING.

After preparing the general list of headings as above, prepare the list of subheadings in general, thus: under "GENERAL CONDITIONS" we would have the divisions "Material and Labor," "The Contractor," "The Architect," "The Drawings and Specifications," "Details," "Time for Completion," etc.; under "EXCAVATION," "Preparation of Site," etc.

The following is illustrative of the form in which the requirements and conditions should be put:

SPECIFICATION

GENERAL CONDITIONS

Materials and Labor. All materials and labor required for the complete execution of the work are to be of the best quality unless otherwise provided, and are to be furnished in place by the Contractor; also all scaffolding, apparatus, etc.

The Contractor. Personal superintendence is to be given by the Contractor to the work, and a competent foreman is to be at all times on the work. He is to lay out the work carefully, and will be held responsible for any mistakes which he, or any one in his employ, or any of his sub-contractors, may make.

He is to be responsible, also, for any accidents either to person or property, which may occur in connection with the execution of the work either directly or indirectly, for which otherwise the Owner might suffer.

He is to obtain all permits from the city officials required by ordinances; is to pay all fees for water supply, sewer connections, etc.; and is to follow all the requirements of the building laws whether incorporated in this specification or not.

He is to be responsible for all materials, whether incorporated in the building or not, until the final acceptance of the work; and any damage there may be from any cause is to be repaired; or, if beyond repair, the damaged portion is to be replaced.

He is to keep the building fully insured; and all policies are to be so drawn that the loss, if any, is to be paid to the Owner as his interest may appear.

He is to provide such fences as will be required to protect adjoining property.

The Architect. The Architect will have charge of the work, and is to exercise such supervision as will enable him to determine whether the true spirit and intent of the drawings and specification is being carried out. If, in the exercise of this function, he finds that any employee of the Contractor is, through incompetence or wilfulness, a detriment to the work, he will file with the Contractor definite charges; and, upon the filing of such charges, the Contractor will discontinue the services of such employee in connection with this work.

The Architect will issue on the third of each month a voucher calling for ninety (90) per cent of the value of labor and material incorporated completely in place in the building on the first of the month, which voucher will be honored on presentation to the Owner; but this clause will not require the Architect to include in the voucher the value of any material placed in the building which in his opinion does not meet the contract requirements.

The Architect will be the interpreter of the intent and meaning of the drawings and specification, and his decision shall be final and binding on both Owner and Contractor.

Drawings and Specification. The drawings and specification are to be considered as co-operative; and the work or material called for by one and not indicated or mentioned in the other, is to be furnished and done as though fully treated in both.

If no figures or memoranda are given, drawings are to be accurately followed according to scale; but wherever there are figures or memoranda, these are to be followed instead of the scale, if there is a discrepancy.

Detail drawings will be furnished of such portions of the work as the Architect may desire to explain more fully; and any work constructed without such drawings (except by permission expressly obtained), or not in accordance with them, must be taken down and replaced at the Contractor's expense.

No changes are to be made without written order signed by the Architect; and the adjustment, whether allowance or extra expense, is to be made at that time.

Time for Completion. Work is to commence at once, and is to proceed with promptness and despatch.

Completion of work and delivery of building to Owner, to be six months after date of contract. Times of completion of the different parts to be as follows, the time allowed in each case to be from date of signing contract.

Foundation ready for sill	One month.
Frame enclosed and chimney completed	Two months.
Outside finish on	Three months and fifteen days.
Plastering	Four months.
Interior woodwork	Five months and fifteen days.
Painter's work and completion	Six months.

(Month and day to be inserted in contract and specification for each period mentioned above.)

EXCAVATION

Note to Student.—For this part of the work, it is of advantage to draw a *lot plan.* This should show the system of drainage, which, if not included in the Architect's drawings, is often not very satisfactorily studied or understood. This part of the work, however, often depends on local conditions or customs in different towns, and for that reason is not made a part of the general contract. The drainage and water supply are often taken care of by the city or town authorities, the pipe being carried either to the lot line or to the outside of the building wall. The Architect has to ascertain what the system is, and to write his specification accordingly.

A datum* line (if not already given) should be established by the Engineer's level, at the sidewalk curb. This should be obtained for use in making the sketches and plans, and should be referred to frequently. If the first-floor level is determined in the studies with relation to this datum line—or "bench mark," as it is often called—the location of the building will be much more easily determined. If the lot plan is kept separate from the drawings, it can be contoured to show the different levels; and sections can be drawn on the margin to show the slope of the land. This plan can also be used for locating drainage and water and gas supplies.

The parts of the drawings referring to the excavator's work should be as carefully studied as those relating to any other part of the building operations. If possible, borings should be made on the lot before commencing the drawings, so that the character of the soil can be determined.

A few dollars spent by the Owner for borings on the lot and for a careful survey, will be more than repaid by certainty in the excavator's estimate.

Preparation of Site. The Contractor will stake out the building, and will erect permanent batter-boards at such points that they will not be disturbed during the construction of the foundations.

Clear away lot for building, removing soil and loam from site and 8 feet additional and stacking it within forty feet from the building where it may be used for final grading. Remove rubbish, cut down and remove any trees marked as condemned by Owner or Architect, and carefully protect all trees that are to be preserved.

Excavation. Excavate for all work covered by this contract, to at least one foot outside the cellar wall to the depth shown, and no deeper. This includes drains, dry wells and trenches, as well as cellar. Dry well for refrigerator waste to be 3 feet in diameter, 6 feet deep, with trench to same 5 feet deep and 8 feet long.

Trench under cellar wall to slope to drain cellar. No walls or piers to start less than 4 feet 6 inches below surface of ground.

Excavate for water pipe, gas, fresh-air ducts, and for drain and cesspool about 40 feet from house. Excavate for piazza piers and for chimney footings.

---

*NOTE.—For convenience in engineering operations, there is established in each locality a *datum line*—that is, a horizontal line passing through a certain fixed point marked zero (0). Levels above this are marked thus, "+15," "+20," etc., which means that these particular points are 15 feet, 20 feet, etc., above the fixed point. In coast regions, this datum line is often fixed at low-water mark.

All city grades are figured from the datum line; and to establish such a line at a building is to fix a level at the required number of feet above the original. Thus, on the seacoast, the levels may run down to +10 or +18; while in Denver, which is at comparatively high altitude, is a datum line or bench mark + one mile (or +5,280 feet). In such localities it is usual to drop the first two figures and call the bench "+80."

After mortar of foundation walls is set fill with stone and gravel to within 18 inches of finished grade; and after first floor joists are set, complete filling, tamping every foot in height.

Grade to level shown on drawings, so as to turn water away from building, using earth and top-soil first removed.

Grade at completion as directed, removing loam where filling is called for, and covering with 12 inches of loam for lawn, and 18 inches depth of loam for shrub plantation. Paths where shown, excavated 12 inches deep, filled with gravel, made to crown 2 inches. Sod, 2 feet wide on border of path and lawn, and 3 feet next to building. Lawn to be leveled, raked clear of stones, and sown with best approved grass seed. To be properly watered and cared for until completion and delivery of building. Allow one hundred dollars ($100.00) for shrubs delivered, and plant same.

Lime, Cement, and Sand. All lime to be best quality *Rockland* or its equal, freshly burned; and all cement equal to first quality *Rosendale.* Brands to be approved by Architect. All sand to be clean and sharp. Portland cement, first quality, equal to Alpha.

Mortar. Except where otherwise specified, proportions to be:

Lime mortar—One part lime to three parts sand.

Lime-Rosendale cement mortar, or "half-cement" mortar—One part Rosendale cement, 1 part lime, 5 parts sand.

Lime-Portland cement mortar—One part Portland cement, 2 parts lime, 4 parts sand.

Rosendale cement mortar—One part Rosendale cement to 2 of sand.

Portland cement mortar—One part Portland cement to 2 of sand.

STONE WORK

Walls. Furnish all materials and build walls and footings as shown on drawings, of good local stone in irregular courses, the first twelve inches to be laid dry in the trenches, and the remainder to be laid in "half-cement" mortar. The whole to be laid to a line on outside face, well bonded; the joints to be thoroughly filled with mortar, and all to be pointed inside and outside the whole height, holding the trowel so as to weather the pointing on the outside.

There shall be at least one through bond-stone to every ten square feet of wall.

Carefully bevel the walls to receive the sills, and embed in mortar.

Cellar window-sills to have wash formed with Portland cement.

Cement Coating. To be given outside of wall below grade on the up-hill side of building, from bottom to finished grade, of mortar composed of one part Portland cement to one part sand.

Cut out joints of exterior wall where exposed above grade one-half inch deep, and point neatly with Portland cement mortar.

Drain Pipe and Cesspool. To be 5-inch best-glazed earthenware drain-pipe, furnished and laid from sewer in street to a point 5 feet outside cellar wall, joints filled with Portland cement. Connection to be made by plumber.

Construct at a point about 40 feet from house two cesspools as shown—one 2 feet 8 inches in diameter and 8 feet deep, with 8-inch brick walls thoroughly cemented inside and made water-tight.

Also, 6 feet from same, a leaching cesspool 4 feet in diameter and 8 feet deep, made of loose stone, laid dry.

From iron pipe outside of building, connect house with cesspool by 4-inch Portland stoneware pipe. Also connect the two cesspools with Portland stoneware pipe as shown.

Cemented cesspool to have tight iron cover. Leaching cesspool to have a ventilated iron cover.

Four-inch glazed earthenware pipe to be furnished and laid from dry wells to one foot above ground, for conductor drains and set iron pipe furnished by plumber to receive conductors.

Cellar Floor (concrete). To be laid in basement. Level off with coarse gravel; settle thoroughly; and put down 3 inches concrete, composed, to the thickness of 2 inches, of 1 part Portland cement, 2 parts sand, and 3 parts clean, coarse, sharp gravel, well tamped; cover with 1-inch coat composed of 1 part Portland cement and 2 parts sand, finished to true and even surface so that cellar will drain dry.

BRICKWORK

Brickwork—Except as otherwise specified, to be laid of hard-burned common brick, carefully selected for exposed work such as facing of chimneys above roof; all to be new, well shaped, and of uniform size. Brick to be laid wet in warm, dry weather, and dry in damp or freezing weather. All mortar to be Lime Rosendale. Joints to be thoroughly flushed with mortar and well pointed. All outside exposed work to be washed down after completion.

Chimneys. The chimneys are to be laid in Portland cement mortar. Build in lead counterflashing, at least 2 inches into the mortar joint, and turn down over the roof flashing.

Plaster the exterior of all chimneys where not exposed.

The chimney caps are to be of 2-inch blue stone, using only one piece to each chimney; the flue-holes cut through, to be one-half inch smaller each way than the flue below.

All flues are to be lined with hard-burned terra-cotta one inch thick, set with very close joints filled with Portland cement mortar.

Terra-cotta round thimbles are to be set for all smoke inlets; and in the ventilation flue, a square opening for registers is to be formed with square, smooth brick.

Chimney bars, to support flat arches, two 2-inch by ½-inch wrought iron, are to be placed above each fireplace, 8 inches longer than opening.

Provide and build into bottom of each chimney one 8-inch by 10-inch cast-iron door and frame.

Trimmer arches to be turned for hearths on center of fireplace, to be 2 feet wide and of length equal to hearths. Level up with cement to receive hearth.

Run 4-inch by 8-inch ash-flues from first-story fireplaces to ash-pit.

Finished fireplaces to be formed as shown in detail drawings—face, back, and fire-bed of 1½-inch Philadelphia brick, with hearths of red, unglazed kitchen tile, or same as face, to have two 2-inch by ½-inch bars, cast-iron throat, patent damper and slide, and ash-dump. After completion, each fireplace is to be kept protected. Samples of brick and tile are to be submitted for approval.

Plastering.—*Lathing.* Lath all walls, ceilings, and partitions (except behind sheathing in kitchen, but including all space behind all other sheathing and wainscots); also all furring, studding, soffits, and under-side of stairs throughout first, second, and third stories, laundry, head of stairs to basement, and cellar ceiling (but not where marked "unfinished" on the plans), with good spruce laths, set three-eighths inch apart and nailed with four nailings to a lath. Break joints every sixth course, and over all door and window openings. All laths to be put on horizontally. Metal lath over heater in basement.

Two-coat Work. Plaster all above-mentioned lathing two coats.

The tough coat shall be best, thoroughly slaked, pure Eastern lime; clean sharp sand; and best, long cattle or goat's hair, mixed in the proportion of 2½ bushels hair to 1 cask lime and 3 barrels sand, to be thoroughly worked and stacked outside of building at least ten days before using. Carry first coat to rough floor. All to be well troweled and straightened up with a straight edge.

The skim coat shall be sand finish, of white, well washed sand, 3 parts sand to 1 part white lime putty, floated up with cork floats, left medium rough; sample to be approved by Architect.

Whitewash. Whitewash all brick or stone work, etc., in basement, two coats, using good lime and plaster of Paris.

Metal corner beads (of approved make) to be furnished and set by plasterer throughout first floor, main house.

Cornices. Cornices to be run in rooms listed below, as per detail drawings.

Living room,
Parlor,
Dining room,
Hall

Metal Work.—*Flashings.* Wherever roofs come in contact with vertical surfaces 5-lb. lead flashings, 9 inches by 9 inches, are to be built into each shingle joint and turned up onto the vertical surface at least five inches. Over these flashings, counter-flashings are to be placed, built into the brickwork as above specified; or, where the vertical surfaces are of shingle or siding, they are to extend under such surfaces at least 6 inches.

All valleys are to be lined with 5-lb. lead extending 6 inches under shingles at each side.

Eave-Trough and Conductors. The eave-troughs and conductors are to be of No. 26 galvanized iron, the conductors to be crimped 3 by 4 inches and connected six feet above ground to the 4-inch soil pipe to drain.

All work in connection with the eave-troughs and conductors is to be riveted when possible, and all joints soldered; and the expansion and contraction from changes in temperature are to be guarded against by expansion joints or loose ends.

CARPENTER WORK

Framing. The building is to be full-frame, all framed, braced, spiked, and pinned in the best and strongest manner, perfectly true and plumb. Filling-in studs will be nailed, and door and window caps cut into studs. No woodwork shall come within one inch of a chimney; and framing must be arranged to avoid cutting for pipes, chimney, etc. Truss all openings over three feet wide.

Timber, except where otherwise specified, to be of spruce. All timber throughout the building to be full and square to the dimensions indicated, well seasoned, and free from large or loose knots, sap, shakes, or other imperfections impairing durability or strength.

Dimensions to be as follows:—

Sills, 6 by 8 inches.
Girders, 8 by 10 inches.
Posts, 4 by 8 inches.
Girts, 4 by 8 inches.
Ledger boards (used only in subordinate framing), 1 by 6-inch hard pine.
Braces, 3 by 4 inches long.
Studding, 2 by 4 inches, 16 inches on centers.
Door and window studs, double, 2 by 4 inches.
Door and window heads 3 by 4 inches.
Partition caps, 2 by 4 inches, hard pine.
Partition soles, 2 by 4 inches.
Joists, first and second floors, 2 by 10 inches; attic, 2 by 8 inches —16 inches on centers.
Plate, 2 by 4 inches, double, breaking joints.
Rafters, 2 by 8 inches, 20 inches on centers.
Valley rafters, 3 by 10 inches.
Ridges, 2 by 8 inches.
Piazza and porch girders, 4 by 8 inches.
Piazza and porch sills, 4 by 8 inches.
Piazza and porch floor beams, 2 by 8 inches, 20 inches on centers.

Halve (or frame and pin) sills at angles. Frame corner posts and door and window studs to sill and girt. Floor beams to be notched down on sill, and gained in.

Double joists under all partitions not over partitions below running parallel with the joists, where supports to span are 10 feet or less; under all other, triple the joists.

All headers and trimmers 8 feet long or less are to be doubled; all longer, tripled.

Bridge all floors every eight feet with 1 by 3-inch pieces cut diagonally and double-nailed at each end.

All studs are to be 2 by 4 inches, 16 inches on centers, straight and plumb. Partitions directly over walls and girders in cellar, or with partition caps below, are to run down to rest on them. Strongly truss all partitions not supported from below. Spike studs at corners. Line sliding-door pockets with ½-inch matched sheathing.

Piazza joists to pitch 1 inch in 5 feet away from house.

Main Roof. To be framed in the strongest manner, with valley rafters carried to ridge or hips. All hips and ridges to be maintained perfectly straight. Rafters to be notched over the plate, and spiked. Double the rafters at each side of dormer openings; 4 by 8 inch header, 8 feet above top floor. Partitions to be carried up to support roof wherever practicable. All to be thoroughly tied, and made perfectly secure and strong. Collar beams, 2 by 6 inches, 8 feet 2 inches above attic floor.

Dormers to be framed with 4 by 4-inch corner posts, 2 by 4-inch studding and plate, and 2 by 6-inch rafters. Studding to be notched 1 inch on rafters and extend to the floor.

Boarding. Cover all roofs and frame walls with good, sound spruce boards not over 10 inches wide; roof square-edged; walls matched and laid diagonally. Cover walls with "Neponset" black sheathing paper, or its equal.

Shingles. Cover all roofs with "Extra" sawed cedar shingles, laid 5 inches to the weather, with two nails to each shingle. Double-shingle all hips. Ridge to be finished with 6 by ⅞-inch saddle boards.

Walls. Cover all walls with "clear" sawed cedar shingles, 5½ inches to the weather.

Exterior Finish. Exterior finish not otherwise specified, to be worked from good cypress, clear of sap, shakes, and large or black knots, following elevation and detail drawings; and to be put up in a skilful manner, with close joints and with nails sunk for puttying. Joints exposed to the weather, to be matched and painted with thick white lead before putting the pieces together. The painter to prime finish before or immediately after putting up.

Main Cornices. To be according to detail drawings, with 5 by 7-inch cypress gutter, fascia, planceer, rebated 1¼-inch belt above clapboards, mouldings, dentil course, and brackets.

Cellar Hatchway. To have 2-inch plank treads on 2-inch carriages, 16 inches on centers; 2-inch plank sills, and trap-door frame, bolted to masonry. Case with ⅞-inch cypress, and make doors of narrow cypress, the doors to be well cleated. Make water-tight. To have heavy strap hinges and proper fastening. Single door at foot of stairs.

Porch and Piazza Floors. To be laid with ⅞-inch by 3-inch Georgia pine dressed one side, upper edge eased off; laid ⅛ inch apart, nailed with 8-penny nails. Finish with rounded nosing and ⅞-inch by 1-inch mouldings. Floors to pitch to throw off water.

Outside Steps. To be constructed with 2 by 10-inch plank carriages, 16 inches on centers.

Treads of outside steps to be of ⅞-inch by 4-inch hard pine strips, with rounded nosings and coving under, returned at the ends. Risers ⅞-inch thick.

Ceiling of covered porch and piazza to be of ⅝-inch by 2½-inch tongued, grooved, and beaded North Carolina pine.

Columns. To be built up of white pine, with turned shafts of diameter as shown for lower third and diminishing slightly above, with moulded caps and moulded bases.

Balustrade. At floor and at roof of porch and side piazza, and over dining-room bay, to be of 2¼-inch stock, 2 inches apart, turned.

Posts. Posts on porch and piazza roofs are to be built up with turned finials, and supported by pieces running up from plate or sill inside of posts.

Top rail to be built up and moulded; lower rail, 2 by 3 inches, solid, beveled.

Window-Frames and Scuttle. Plank frames in stonework in basement, except where shown double-hung, are to be of 1¾ by 6-inch pine, with ⅞ by 1¾-inch moulded staff bead, and 2¾-inch sill. Frames to be rebated on the outer edge for screens. Sash to be hung at the top, to swing in.

All windows shown with meeting rail, or unless otherwise specified, to have pine frames made for double-hung sashes, with ⅞-inch hard pine pulley stiles, tongued into outside casings, beads, ¾-inch ground casings, 1⅜-inch yokes, 2¾-inch sills to pitch 1½ inches, ⅞-inch by 5-inch outside casing over boarding, with 1¾ by 2¼-inch back band window caps as shown. To have 2-inch bronze-faced axle pulleys.

Scuttle. To be 2 feet by 2 feet, with plank frame 6 inches high. Heavy strap hinges, and fixtures to hold cover at any angle. Frame and cover to be tinned.

Door-Frames and Doors.—*Outside Door-Frames.* To be made from clear pine stock, 1⅞ inches thick, rebated and beaded on inner edge, and with 1¾-inch hard pine thresholds. Casing of outside door-frames to correspond with windows.

Inside Door Frames. All inside swinging doors to have 1¾-inch double-rebated and beaded frames of pine or whitewood to match adjacent finish. Veneer for other woods with ¼-inch veneer on 1¼-inch pine.

Sash. Sash to be of white pine, unless otherwise specified. In first story 1¾ inches thick; in second and third stories, and all of ell, to be 1½-inches thick; in cellar, 1¼ inches thick. Large one-light sash to have 1½-inch meeting rails. Sash not to be stained.

Doors. Doors, except stock doors, to be paneled and moulded according to scale and detail drawings. All panels to be loose and not glued or nailed. Tenons to have ¾-inch haunches. Outside veneered doors to be 2¼ inches thick; doors 3 feet wide and over, to be 2 inches thick; all others, 1¾ inches.

Front and Rear Hall Doors. Are to be 2¼ inches thick, of white pine, veneered inside to match vestibule, lower panels raised, upper panel glazed with polished plate glass.

Other Outside Doors. To be 1¾-inch pine stock sash doors, as shown, with wood muntins, glazed with double-thick glass.

Sliding Doors. To have astragal joint at center, and ⅝-inch by 1¼-inch friction mould all around; to slide on Richards or other approved patent hangers, on birch track.

Dwarf doors for wardrobes, cupboards, pantry, etc., to be solid paneled, 1¼ inches thick.

Build cellar door of ⅞-inch stock.

Doors not veneered, to be of solid pine, whitewood, cypress, or birch, to match room.

Doors in rooms having hardwood finish, to have thoroughly kiln-dried, white pine core, with solid mouldings and ¼-inch veneering of kiln-dried wood ¾-inch on edges, well glued on both sides to match hardwood finish of rooms. If one of two adjacent rooms is to be painted, veneer door with hardwood of other room, on both sides.

All panels over 15 inches wide to be glued up.

Stock Doors. To be 1¾ inches thick, stock sizes; with plain panels and flush mouldings on both sides, 4 panels. Architect to approve sample showing quality and arrangement of panels.

Blinds. Blinds are to be hung for all windows. They are to be of cypress or of white pine, 1⅛ inches thick. Mark each blind to correspond with mark on window-opening.

Screens. To be furnished and set, for all outside doors and windows that open; made from best, clear, thoroughly seasoned white pine, ⅞-inch thick, to be stained and varnished three coats. Screens are to be fitted with lifts, springs, and runs, so that they can be used for either upper or lower half of sash, with adjustable run.

Wood frames to be covered with 14-mesh best approved galvanized wire, using heavy 13-mesh for doors and cellar windows.

Grounds and Furring. Furr ceilings and rafters in finished portion of attic with 1 by 2-inch spruce furring strips, 12 inches on centers, nailed to every beam; and furr out in finished attic rooms for 3-foot 6-inch walls, also for plastering next basement walls, with 2 by 4-inch studding set flat.

Put grounds for ¾-inch plastering around all door and window openings where there is no ground casing; and for base, wainscot, wood cornice, etc., as directed. Two grounds behind base.

Put corner beads on all projecting angles; secure well; set true and plumb.

Under-Floors. Lay under-floors, except in basement, of good, square-edged spruce boards, surfaced on one side to even thickness, and nailed to every bearing with two 8-penny nails. End joints to be cut over beam in every case.

Sheathing Paper. Lay two thicknesses of approved sheathing paper between the under and the finished floors.

Interior Finish.—*Material, Etc.* All stock to be best quality, unless otherwise specified, free from knots or sap, thoroughly seasoned or kiln-dried. All to be smoothed, scraped, and sandpapered by hand before putting up and at completion; such work as is to have a natural finish, to be properly cleaned. No interior finish to be taken into building until plastering is dry.

Priming back of Finish. Standing finish to be given a priming coat on back by Contractor furnishing interior finish before it leaves the shop.

Curved Finish. Is to be sprung on or worked from large stock, so that no kerf marks can be seen.

Main House Finish. All finish on main part of house, except inside of closets, to be moulded.

Service Finish. All parts of the building devoted to service and inside of closets, to have flat finish.

Wainscot Sheathing. Four feet high, North Carolina pine, to be set in back entry, kitchen, and bathroom, matched and beaded like approved sample, ⅞ inch by 2½ inches, with 1½-inch rebated cap and no base.

Paneled Wainscot. To be 3 feet high, paneled as shown, with raised panels. To have 6-inch base, moulded cap, ⅞-inch rails and stiles, loose panels.

SCHEDULE:—To be used in dining room.

Birch. Unless otherwise specified, all birch to be best selected first quality, red birch, of even color.

SCHEDULE:—To be used in dining room.

Oak. Unless otherwise specified, all oak to be best selected thoroughly seasoned American quartered white oak, to show good grain, and to be free from shakes, knots, stains, or any other imperfections.

North Carolina Hard Pine. Unless otherwise specified, to be selected first quality.

SCHEDULE:—To be used as follows:

Back Entry.
Kitchen.
Pantry.
China Closet.
Bathroom.

Picture Moulding. Of same wood as finish, around principal rooms of first story, 1⅛ by 2½ inches; around all chambers, second story, main house, ⅞ inch by ¾ inch. Unless otherwise directed, to be 1 foot 6 inches below ceiling; and where there is a cornice, ½ inch below cornice. Picture moulding to be finished by painter, except last coat, before putting up.

Closets. To have high shelf and strips all around, for clothes hooks. Unless otherwise directed, shelf to be ⅞ inch by 14 inches, 5 feet 10 inches above floor, with hook rows at 4 feet 6 inches and 5 feet 6 inches above floor.

Linen Closet. To have counter shelf, with four drawers below, and with shelves above, 16 inches apart, extending to ceiling; these to be fitted with doors hinged at bottom to drop down.

China Closet. To have counter shelf 2 feet 8 inches above floor; paneled, hinged doors and 8 drawers, one drawer subdivided, under; hinged, glazed doors and 5 shelves, over. Frame for sink. High closet over sink, to have glazed doors and 3 shelves. To have 8 inches clear space over counter shelf.

Pantry. To have counter shelf as shown 2 feet 8 inches high, with four ⅞-inch by 14-inch shelves above, and 4 drawers below, one drawer being divided for knives, etc.; space for 2 flour-bins with doors; remainder of space to have shelving enclosed by sheathed doors. All this to be of clear white pine or whitewood, for natural finish.

Broom Rack. To be put up in broom closet or in cellar stairway; to have cast-iron holders for sweeping and whisk brooms, dustpan, fire bucket, etc., to be included in hardware.

Tank in Attic. To be built of 2-inch plank, tongued and grooved, fastened together with iron rods and nuts, to be well cleated. To be 4 feet by 4 feet by 2 feet.

Plumbing Strips. To be put up to support pipe where required by plumber. Water-closet seats and tanks, except in attic, to be furnished by plumber.

Mantels. Allow a total sum of $125.00 for wood mantels delivered at house, to be selected by Owner, set by carpenter, and finished by painter.

Finish Floors. Upper floor is not to be laid where there are double floors, until standing finish is all in place. All lining floors to be thoroughly repaired and cleaned before finish floor is laid.

Oak Floors. To be in first floor of main house, except in kitchen, of matched quartered-oak flooring, ⅞ inch by 2½ inches, clear, thoroughly seasoned, and kiln-dried, blind-nailed to every bearing with 8-penny nails, laid over rough floor, to be planed off, scraped, and sandpapered ready for finishing. Protect properly.

Hard Pine Floors. Hard pine floors, in kitchen, pantries, and bathroom, to be of ⅞-inch by 2½-inch matched-rift Georgia pine.

Hardware. To cost one hundred and fifty dollars ($150.00) for all trimmings of doors and windows, and fittings in china closet and pantry, closets, drawers, etc., allowance to cover *net* cost to Contractor; Architect or Owner to select hardware where he chooses; and Owner to have benefit of any deduction from allowance. Carpenter to furnish correct list of hardware, and to put it on carefully and in workmanlike manner.

Painting.—*Samples.* Samples of all colors to be submitted for Architect's approval.

Knots and Defects. Sap, pitch, knots, and similar defects, to be covered with good-quality shellac.

Number of Coats. Unless expressly so indicated, priming and shellacing is not to count as a coat in this specification.

Exterior Finish. All dressed exterior finish, blinds, and sash, to be painted two coats, after priming, of white lead and linseed oil

Hard Pine. Pulley stiles and floors, and steps of porches, to receive two coats oil, well rubbed in.

Following is a general memorandum of exterior painting. This is to be compared with plans, and all work is to be left with painter's finish complete.

SCHEDULE: —

Finish, 2 coats paint after priming.
Porch Floors, 2 coats oil.
Blinds, 3 coats.
Metal, 3 coats.
Shingles, natural.

Inside Finish. Except where otherwise specified, all inside finish is to be well filled, and is to have one coat stain and shellac and two coats of dead hard oil finish. All work about kitchen and bathrooms to have two coats of hard oil with high gloss.

Ivory White. Where indicated, give one coat shellac, then 3 coats lead and oil paint, sandpapering each coat; then 2 coats white lead, zinc, and white varnish, rubbing down with pumice-stone and oil; sample and tint to be approved.

Whitewood Finish. Whitewood and other finish, unless otherwise specified, to have three good coats lead and oil. Color as approved; last coat to have suitable proportion of zinc, and to be left with flat or oil finish.

Hardwood. Treat hardwood finish according to best methods with potash; give coat of oil or paste filler; clean off; give 4 coats of white shellac, sandpapering after each coat except last, which is to be rubbed to dull finish with pumice-stone and oil.

Enamel White. Give one coat shellac; then 4 coats lead and oil paint, sandpapering each coat; then 2 coats white varnish, rubbed each with pumice-stone and oil, sample to be approved.

Standing Hard-Pine Finish. Standing hard-pine finish to be given one coat approved primer and filler, sandpapered; one coat approved inside spar varnish, rubbed down; and one coat approved inside spar varnish, flowed on.

SCHEDULE:—Kitchen, pantry, serving room, bathroom.

Bathtub. Bathtub to be painted outside, four coats; last coat to be an enamel gloss coat.

Exposed Piping. All piping that shows, to be given one coat of white shellac.

Plaster Walls and Ceilings. Plaster walls, but not ceilings, in kitchen, pantry, and china closet and throughout bathroom, to be painted 1 coat sizing and 3 coats paint, last coat to contain varnish to leave gloss. All ceilings to be sized and tinted.

Glazing.—*Plate Glass.* Furnish and set ¼-inch American polished plate glass for large lights in main house.

Double-Thick Glass. Glass not otherwise specified, to be first-quality double-thick German or American glass.

At completion, all glass to be thoroughly cleaned from oil, putty, paint, mortar, and plaster, and to be left whole.

Heating.—*Furnace.* Provide and set up complete, where shown on plans, a hot-air furnace of *approved* make, to be of *cast iron*, with stated and sufficient area of grate and heating capacity to keep building at 70° temperature, Fahrenheit, when thermometer is at zero outside.

Smoke Pipe. To be 9-inch black iron pipe, fitted with close-fitting damper, also check-damper and proper cleanouts.

Tinwork. Furnish and set warm-air pipes and register boxes, to be of bright IX tinplate. Mark each pipe with the name of room it supplies. Cover risers with metal lath in partitions before plastering.

Dampers, Etc. Dampers for warm-air pipes, netting for register boxes, tin collars, casings, lining tin for protection from fire, to be supplied and set by Contractor.

The cold-air box is to be No. 24 galvanized iron, with all joints riveted tight, and with such bracing as will effectually prevent the sagging of the top. It is to be fitted to the cold-air inlet and at delivery inlet, and is to have a balanced, close-fitting damper which, when open, will give full passageway for air.

Registers. Furnish registers and connect to pipes, with valves in each. Registers to be of black-Japanned cast iron, with tin boxes and borders. In library, register is to be bronze; and in reception room, of white enamel, approved quality and design.

SCHEDULE:—Registers are to be laid out according to an approved schedule submitted by each bidder, showing size, finish, etc., for each room, with size of supply pipe. Locations are to be as shown on plans or as approved in building, before proceeding with work.

Plumbing.—*Materials, Connections, Etc.* All drain, soil, waste, and vent pipes, and all fittings, are to be extra-heavy plain cast iron, painted outside 2 coats red lead.

Joints. All joints in cast-iron pipe are to be made tight with oakum and lead, well calked.

Lead Pipes. All lead, waste, and vent pipe branches are to be of best-quality drawn lead, of the following weights per foot:

1½-inch	3 lbs.
2 -inch	4 lbs.
3 -inch	6 lbs.
4 -inch	8 lbs.

Connections of Lead and Iron Pipes. All connections of lead and iron pipes are to be made by heavy brass ferrules, same size as lead, calked with lead.

Joints between ferrules and lead pipes, to be wiped.

All lead pipe joints to be wiped.

Supports. All vertical lines of soil and waste pipes, if not carried to drain below cellar floor, are to rest on brick piers at their base.

All vertical lines of iron pipe are to be held in place by pipe hangers or wrought-iron clamps, placed 5 feet apart. In horizontal lines, they must be not more than 10 feet apart.

All lead pipes are to be secured in place with metal tacks or brass clamps, placed 3 feet apart; and horizontal pipes are to be supported their entire length by carrying strips.

All brass pipe to be secure by brass pipe holders approved by the Architect.

Miscellaneous. All horizontal drain and waste pipes are to have a fall of not less than ¼ inch to the foot.

All changes in direction must be made with Y (45°), ⅛ (22½°), or $\frac{1}{16}$ (11¼°) branches.

All connections with horizontal pipes must be made by Y branches. TYs (sometimes called "Sanitary Ts") may be used on vertical pipes.

All exposed brass-work to be nickel-plated, except in basement and kitchen, where it is to be polished.

Cleanouts. Set Ys with extra-heavy brass screw-caps at each bend in horizontal lines, and 15 feet apart in straight lines; also cleanouts at ends of all horizontal lines.

All cleanouts to be same diameter as pipes with which they are connected.

Traps and Vents. Every fixture must be separately trapped. No traps are to be less than 1½ inches in diameter. Each set of trays to have one trap.

All traps must be vented—4-inch traps by 2-inch branches; 2 inch and 1½-inch traps, by 1½-inch branches.

Roof Flashings. All joints between roof and iron pipe must be made tight with 6-pound lead or 16-ounce copper flashings.

Tests. The water test must be applied to the entire system of piping, in the Architect's presence and to his satisfaction. All pipes and connections must remain uncovered until they have passed the test.

On completion of the work, after all fixtures are set, the smoke test will be applied, and must prove satisfactory to the Architect.

Drains, Soil and Waste Pipes, and Vents. The plumber will make proper connections from point 10 feet outside of building, with a drain, by 5-inch iron pipe.

Just inside house wall, place a 5-inch running trap with two cleanouts; and 5-inch fresh-air pipe from house side of trap to a point not less than 15 feet from building, opening one foot above ground, with return bend.

Continue drain 5 inches in diameter under cellar wall, and connect the various soil and waste pipes with same.

The trap on main drain must be placed in an accessible brick manhole, with 8-inch walls, and covered with stone or iron cover; and the drain pipes must be laid in a brick trench with stone or iron cover.

Set, where shown on plans, lines of 4-inch soil pipe, or 2-inch waste pipe, as necessary, with proper connections to receive the various fixtures. Carry pipe through roof, and one foot above same, increased one inch in diameter from a point below roof; ends above roof to be left free and unobstructed.

For each line of fixtures, set a 2-inch pipe, with fittings for the various vents. Connect into soil pipe below lowest fixture, and at top well above highest fixture.

All water-closets are to have 2-inch local vents of nickel-plated copper connected to 3-inch spiral galvanized pipe, and carried to chimney, as directed by Architect. All joints in pipes, to be soldered tight.

Under refrigerator, place a copper-lined box 12 by 8 by 6 inches. Carry 1½-inch lead waste pipe from box to basement, with end turned up so as to form a water-sealed trap and capped with light flap valve, to waste into sink or other receptacle provided for the purpose.

Fixtures.—*Water-Closet.* In basement—one washdown closet, with metal outlet of approved pattern, and with oak seat (no cover) attached to bowl with heavy hinges. Plain 12-ounce copper-lined siphon tank, cast-brass gooseneck, valve, high-pressure ball-cock, iron brackets, chain and pull, and 1½-inch brass flush-pipe. Brasswork to be polished.

In bathroom—one siphon-jet closet, with water-covered outlet connection between earthenware and waste pipe; 1¼-inch cherry seat and cover, with heavy hinges, attached to bowl. Cherry service box tank, 8 gallons' capacity, brass brackets, high-pressure ballcock, and 1½-inch brass flush-pipe. Brasswork to be nickel-plated.

Lavatory. In bathroom—one 15 by 19-inch straight back, accessible overflow basin, with brass plug in bowl, operated by rod outside of basin (approved pattern). Bolts and nuts through rim of basin. Top of basin ground. Heavy low-down pattern compression-cocks, disc handles; ½-inch iron-size brass supply pipes; 1½-inch deep-seal S-pattern trap; plain brass brackets of design approved by Architect.

Marble slab to be Italian of best quality, highly polished, and of size and shape as shown on plans, with back 12 inches high.

Slab to be 1¼ inches thick; back, ⅞ inch thick.

Brasswork to be nickel-plated.

Bath. In bathroom—one 5-foot guaranteed-quality, enameled-iron, 3-inch roll-rim bath, flat bottom, approved pattern, with ¾-inch heavy combination compression-cock, disc handles, ¾-inch supply pipes, 1½-inch connected waste and overflow pipes, and plug and chain. Outside of bath to be finished by painter. To waste through 1½-inch bath trap set in floor.

Kitchen Sink. One 36-inch by 24-inch by 8-inch soapstone sink, with 12-inch back, and soap dish. Set on galvanized-iron standards. To waste through 6-inch lead trap. Supply through ¾-inch compression bibs. Hose end on cold cock. Brasswork to be polished.

In china closet—one 24 by 14-inch recessed, 18-ounce, tinned-copper sink, with 1½-inch standing waste and overflow. Waste same as in case of kitchen sink. Supply through tall gooseneck, heavy-pattern compression-cocks. Hose end on cold cock. Brasswork to be nickel-plated.

In laundry—two 24-inch soapstone trays, with 12-inch back, and soap dish, plugs, and chains. Set on galvanized-iron standards.

Range Boiler. One 40-gallon copper boiler on galvanized stand. Connected to range by ¾-inch brass pipe.

All fixtures, except water-closets, to be supplied with hot and cold water.

Water Supply.—*Materials, Etc.* All cold-water pipes and fittings are to be galvanized iron; and all hot-water and circulating pipes are to be iron-size brass, semi-annealed, with all fittings of brass.

Where exposed, brass or nickel-plated pipes are to be supported by brass or nickel-plated hangers.

All exposed supply pipes in bathroom and toilet rooms, to be nickel-plated brass, semi-annealed; in kitchen, polished brass.

All risers to have stop and waste, roundway same size as pipe, in accessible position in cellar, properly tagged.

All supply pipes and branches, to have proper pitch so that they may be readily emptied at their lowest point; and each branch supply of fixtures, to have compression stops, with stuffing-box close to cocks.

Make connection with water main in street by ¾-inch, 4-pound lead pipe; and carry same into building. Just inside wall, place a ¾-inch "Simplex" stop, with ¾-inch stuffing-box hose bib on house side. From stopcock, carry galvanized pipe along on basement ceiling, and take branches to supply various fixtures, as may be necessa

From ¾-inch main, take branches as follows:

For risers	¾ inch.
For sill-cocks	¾ inch.
For tank in attic	¾ inch.

Supplies to fixtures will be:

To lavatory and water-closet tanks	½ inch.
To baths, sinks, and washtrays	¾ inch.
From tank in attic to hot-water boiler	¾ inch.

In attic, where directed by Architect, line a 4 by 4 by 2-inch tank with 14-ounce tinned copper, fitted with ¾-inch high-pressure ball-cock and proper valves. Overflow to run to roof or to laundry traps in basement, as may be directed by the Architect.

Set, where directed by Architect, two ¾-inch nickel-plated wheel-handle sill-cocks, with stuffing-box. Inside of wall, place a ¾-inch "Simplex" stop and waste.

Hot-Water System. Connect hot-water boiler with tank by ¾-inch pipe. Carry ¾-inch brass pipe from boiler, with branches as specified to supply the various fixtures, and ½-inch brass return to boiler. The entire system to circulate freely and thoroughly.

From highest point of system, carry ½-inch expansion pipe to tank, discharging over top of same. Place stop-cocks on supply to boiler and from same.

Gasfitting.—*Description.* Provide and put in gas piping according to this specification, and as shown on plan, according to the rules of the local Gas-Light Company.

Cutting to be done by carpenter, not by gasfitter. No floor beams to be cut further than 2 feet from bearings.

Piping. Piping to be wrought-iron; fittings, of galvanized malleable iron, set with red lead, firmly fastened. Make sure that pipe is free from obstructions, before placing in position. Gasfitters' cement not to be used.

Following is the scale of sizes of pipes and number of burners (not outlets) to be supplied therefrom.

Longest run in feet	20	30	50	70	100	150
Size, pipe, inches	⅜	½	¾	1	½	2
Number of burners	2	4	15	25	40	70

Testing. Piping to be tight under pressure of air equal to column of mercury 6 inches high. Mercury to stand without falling for half an hour. Outlet caps to be loosened to show that they affect testing apparatus, and that there is no obstruction in pipes.

INDEX

Page
Accepted and rejected materials 23
Architect 26
Backfilling 28
Basement floor 31
Blinds 97
Brick 29
Brick masonry 32
Brickwork 90
Broken stone 29
Building conditions 52
Canvas 37
Carpenter work 34, 93
Carpentry construction 35
Cement 12, 29
  fineness of 13
  initial set 14
  non-staining 15
  soundness of 14
Changes in cost 23
Chimneys 91
City laws 24
Cleaning up 44
Concrete work 31
Contract
  definition of 67
  formal 45
Contract between U. S. of A. and John Doe 58
Contract drawings 22
Contractor 4
  responsibility of 23
Contractor's foreman 25
Detail drawings 23
Door-frames and doors 96
Drawings 25
Electric wiring 21
Employer's liability insurance 24
Excavation 28, 87
Face brick 33
Fineness of cement 13
Fixtures 104

Page

Form of agreement between owner and builder 47
Formal contract 45
Gasfitting 107
Gas piping 43
General conditions 22, 85
  accepted and rejected materials 23
  architect 26, 86
  backfilling 28
  changes 23
  city laws 24
  contract drawings 22
  contractor 86
  contractor's foreman 25
  contractor's responsibility 23
  detail drawings 23
  drawings 25, 87
  employer's liability insurance 24
  excavation 28
  ladders and scaffold 24
  materials and labor 85
  payments 26
  samples of materials 24
  sewer connections 28
  site 27
  specification 25
  time for completion 27, 87
  water connections 28
General requirements 19
Glass 39
Glazing 101
Government contracts
  building conditions 52
  buildings underway 51
  character of buildings 51
Granite 30
Grounds and furring 97
Gutters and conductors 38
Hardware 37, 100
Heating 43, 101
Heating dwellings 84
Initial set of cement 14
Interior finish 98
Joists and stringers 34
Ladders 24
Lumber for construction and finish 16
Masonry construction
  basement floor 31
  concrete work 31

Page

Masonry construction
  setting of granite and soft stone........ 33
  setting terra-cotta........ 34
Masonry materials........ 29
  brick........ 29
  broken stone........ 29
  cement........ 29
  granite........ 30
  sand........ 29
  soft stone........ 30
  terra-cotta........ 30
Materials, studies in........ 8
Memorandum specification........ 68
Metal work........ 92
Non-staining cements........ 15
Outline specification........ 22
Outline of work........ 6
Owner........ 3
Paint........ 39
Painting........ 100
Plastering........ 38, 91
Payments........ 26
Plumbing........ 102
Plumbing fixtures........ 39
Preparation of site........ 88
Requirements, general........ 19
Responsibility of contractor........ 23
Roofs........ 17, 37
Rough lumber........ 34
Samples of materials........ 24
Sand........ 8, 29
Scaffold........ 24
Screens........ 97
Setting of granite and soft stone........ 33
Setting terra-cotta........ 34
Sewer connections........ 28
Sheathing paper........ 97
Site........ 27
Soft stone........ 30
Soil pipe........ 41
Soundness of cement........ 14
Specification........ 25
  definition of........ 67
  general province of........ 1
  general scope of........ 67
Specification reminder........ 79
Specification writer........ 5
Stone work........ 89

Page

Stone work
  cellar floor........ 90
  cement coating........ 90
  cesspool........ 90
  drain pipe........ 90
  walls........ 89
Studies in materials........ 8
Studs........ 34
Terra-cotta........ 30
Tile........ 37
Time limit for completion of work........ 27
Traps........ 41
Under-floors........ 97
Use of words........ 19
Water connections........ 28
Water supply........ 105
Whitewash........ 92
Window frames and scuttle........ 95

ANNOUNCEMENT OF COMING BOOKS

PRACTICAL AND SCIENTIFIC

CARPENTRY. By **G. Townsend.** 150 pp., 224 illus. A working manual for Carpenters and Woodworkers in general. Not a theoretical treatise, but a *practical working guide.* Price, **$1.00**

GAS ENGINES AND PRODUCERS. By **Marks and Wyer.** 150 pp., 90 illus. Latest information in this rapidly developing field. For Engineers, Machinists, Automobilists. Price........**$1.00**

MASONRY CONSTRUCTION. By **Phillips and Byrne.** 140 pp., 44 illus. Latest and best American methods. Price........**$1.00**

WATER SUPPLY. By **F. E. Turneaure.** 150 pp., 40 illus. An exhaustive compendium for Sanitary and Waterworks Engineers and all interested in matters affecting public health. Price........**$1.00**

HIGHWAY CONSTRUCTION. By **Phillips and Byrne.** 140 pp., 80 illus. Modern methods for Road Builders and all interested in better ways of communication. Price........**$1.00**

REINFORCED CONCRETE. By **Webb and Gibson.** 150 pp., 140 illus. A manual of practical methods for Architects, Builders, Contractors, Civil and Sanitary Engineers. Information for the first time made known to the world. Based on recent construction work, special tests, etc. Price........**$1.00**

MANAGEMENT OF DYNAMO-ELECTRIC MACHINERY. By **F. B. Crocker.** 130 pp., 65 illus. For all who have to do with electric light or power plants. Price........**$1.00**

STEAM ENGINES. By **Leland and Snow.** 170 pp., 63 illus. A practical guide. Field covered in a way anyone can grasp. Price........**$1.00**

ELECTRIC RAILWAYS. By **J. R. Cravath.** 150 pp., 103 illus. Trolley and third-rail systems, Electric Locomotive, etc. Price........**$1.00**

ESTIMATING. By **Edward Nichols.** 140 pp., 35 illus. For all workers in Building trades. Tells how to estimate intelligently. Price...**$1.00**

CONTRACTS AND SPECIFICATIONS. By **James C. Plant.** 130 pp., fully illustrated. Forms of public and private contracts, specifications, bonds, etc.; duties and responsibilities of Architects, Contractors, and Owners Price........**$1.00**

STAIR-BUILDING AND STEEL SQUARE. By **Hodgson and Williams.** 130 pp., 180 illus. Only up-to-date work on these subjects. Price........**$1.00**

VALVE GEARS AND INDICATORS. By **Leland and Dow.** 150 pp., 105 illus. Two books in one. Types of valves, gears, etc., fully explained. Price........**$1.00**

STRENGTH OF MATERIALS. By **E. R. Maurer.** 140 pp., 58 illus. For Architects, Builders, Steel and Concrete Workers. Enables one to avoid mistakes. Price........**$1.00**

THE ELECTRIC TELEGRAPH. By **Thom and Collins.** 150 pp., 81 illus. Carries along by easy steps to complete mastery Multiplex and Wireless telegraph explained. Price........**$1.00**

MECHANICAL DRAWING. By **E. Kenison.** 160 pp., 140 illus. Complete course in projections, shade lines, intersections and developments, lettering, with exercises and plates. Price........**$1.00**

POWER STATIONS AND TRANSMISSION. By **G. C. Shaad.** 160 pp., 43 illus. For Electrical Workers. Up-to-date practice. Price **$1.00**

PATTERN MAKING. By **James Ritchey.** 150 pp., 250 illus. For Wood and Metal Workers and Molders. Methods of building up and finishing, fully described. Price........**$1.00**

SURVEYING. By **Alfred E. Phillips.** 200 pp., 133 illus. For Civil Engineers and Students. All details of field work explained. Price **$1.50**

STEEL CONSTRUCTION. By **E. A. TUCKER.** 300 pp., 275 illus. Covers every phase of the use of steel in structural work. Based on actual experience, special tests, etc. For Architects, Bridge Builders, Contractors, Civil Engineers. Price........**$1.50**

BUILDING SUPERINTENDENCE. By **E. Nichols** 200 pp., 250 illus. Costly mistakes occur through lack of attention at proper time, hurtful to Owner and discreditable to Architect and Builder. Gives thorough knowledge of methods and materials. Price........**$1.50**

ARCHITECTURAL DRAWING AND LETTERING. By **Bourne, von Holst and Brown.** 200 pp., 55 drawings. Complete course in making working drawings and artistic lettering for architectural purposes. Price........**$1.50**

MACHINE SHOP WORK. By **F. W. Turner.** 200 pp., 200 illus. Meets every requirement of the shopman, from the simplest tools to the most complex turning and milling machines. Price........**$1.50**

TOOL MAKING. By **E. R. Markham.** 200 pp., 325 illus. How to make, how to use tools. Profusely illustrated. Price........**$1.50**

MACHINE DESIGN. By **C. L. Griffin.** 200 pp., 82 designs. Written by one of the foremost authorities of the day. Every illustration represents a new device in machine shop practice. Price........**$1.50**

These volumes are handsomely bound in red art Vellum de Luxe, size 6½ x 9½ inches. Sent prepaid to any part of the world, on receipt of price. Remit by Draft, Postal Order, Express Order, or Registered Letter.

AMERICAN SCHOOL OF CORRESPONDENCE, CHICAGO

LIBRARY
GRADUATE SCHOOL OF ENGINEERING
HARVARD UNIVERSITY

Please sign your name and address on this card, and deposit in box provided.

This book may be kept

ONE WEEK

HARVARD ENGINEERING SCHOOL